February 1, 2008

Mr. Bruce Wolfe, Executive Director
California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94612

SUBJECT: Annual Self-Monitoring Report for former salt pond A18 as required by Order Number R2-2005-0003

Dear Mr. Wolfe:

The enclosed Annual Self-Monitoring Report (SMR) is being submitted in fulfillment of the Waste Discharge Requirements for Pond A18 as described in Order Number R2-2005-0003. This SMR includes a summary of data and studies conducted in 2007 for Pond A18. These studies also provide valuable information for the salt pond restoration effort. A key conclusion from our data is that water discharged with low dissolved oxygen levels has no measurable effect on the receiving water's dissolved oxygen content. The City strived to balance adaptive management closure of discharge gates while maximizing the flow through the pond to improve in-pond water quality by tailoring closure times based on data from the previous week. The City also conducted voluntary in-pond monitoring which is described in the SMR.

This SMR report also includes the required update on the planning effort for future uses of A18, which will be addressed as part of the San Jose/Santa Clara Water Pollution Control Plant (Plant) Master Planning effort. The update includes the findings from the opportunities and constraints analysis performed by H.T. Harvey and Associates for A18.

The City recommends additional analysis in the 2008 dry season to correlate the effect of irradiance on dissolved oxygen in the pond by using data from local agencies. It is expected that this evaluation will provide a better understanding of the relationship between natural climatic factors and pond dissolved oxygen concentrations.

If you have any questions regarding this report, please contact David Tucker at 408-945-5316.

Sincerely,

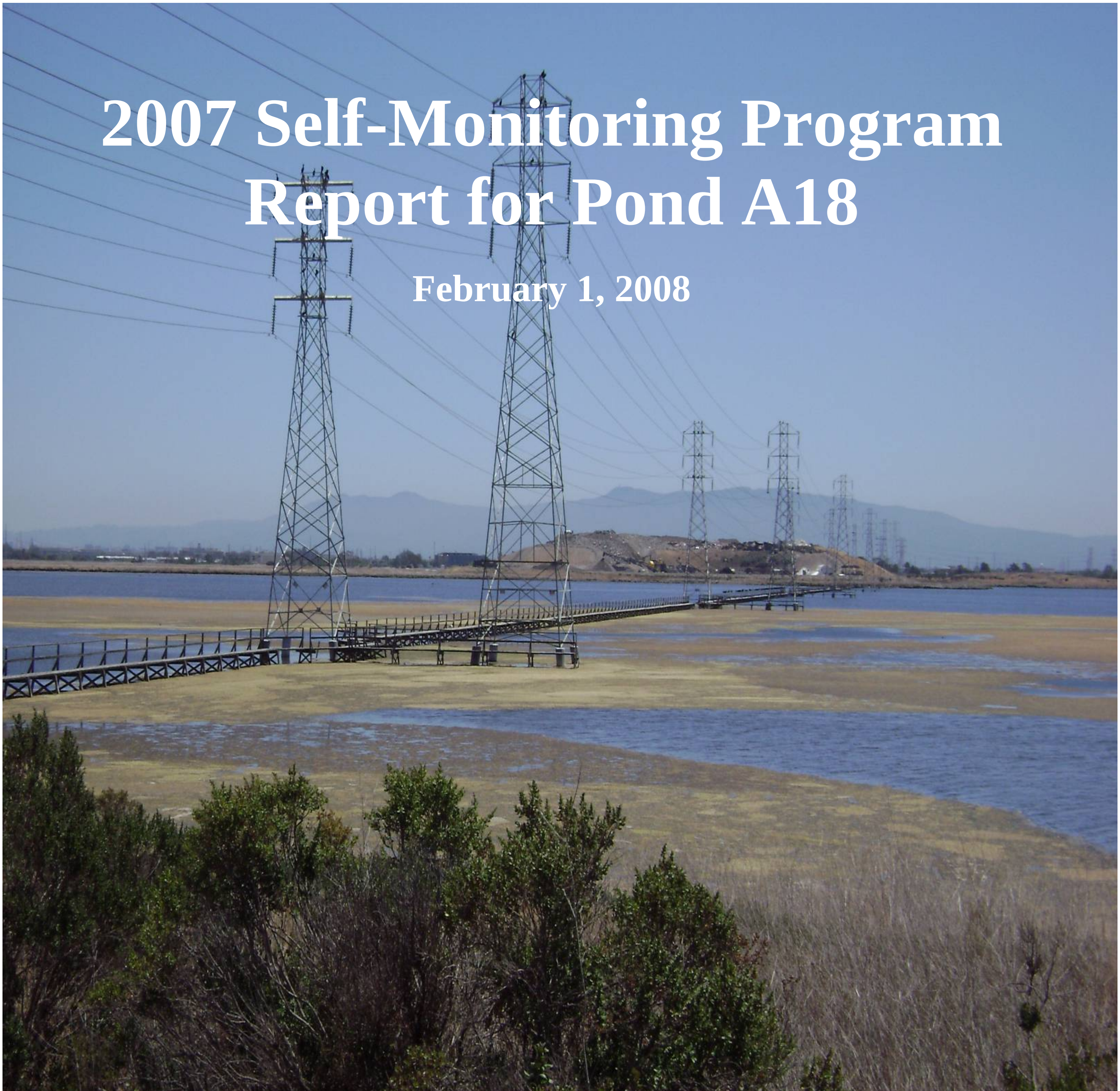
Dale W. Ihrke

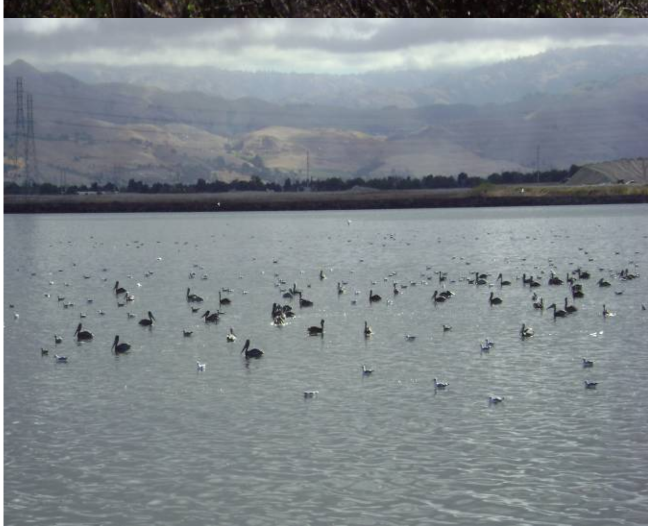
Dale W. Ihrke, P.E.
Deputy Director, Water Pollution Control

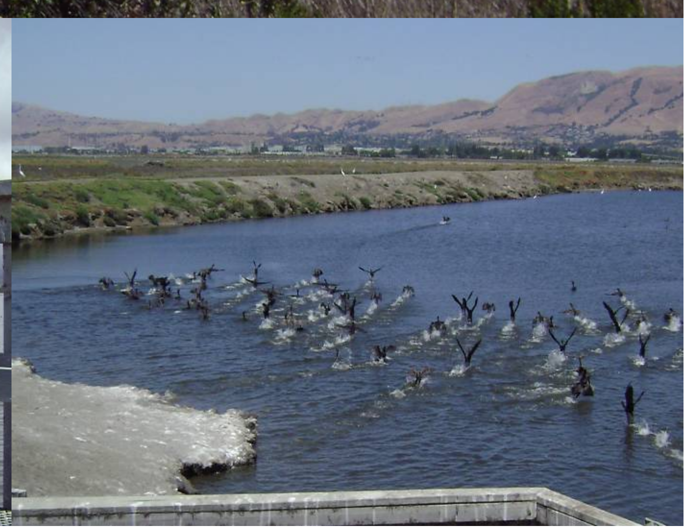
Enc.

2007 Self-Monitoring Program Report for Pond A18

February 1, 2008







2007 Annual Self-Monitoring Program Report for Pond A18 in Santa Clara County

Order No. R2-2005-0003

Prepared for:

California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, CA 94560

Prepared by:

City of San Jose
Environmental Services Department
200 E. Santa Clara, 10th Floor
San Jose, CA 95113

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Table of Contents

List of Tables

List of Figures

Appendices

Appendix 1. Continuous Monitoring of Dissolved Oxygen in Pond A18 and Artesian Slough.
Appendix 2. Monthly Discrete Depth-Profile Measurements of Water Quality at Four Transect Sites in Artesian Slough.
Appendix 3. Comparative Profiles of pH, Salinity and Temperature in A18 and Artesian Slough for Each Month of 2007 Monitoring Season.
Appendix 4. Pond A18 Sediment Mercury Report.
Appendix 5. 2007 Communications.
Appendix 6. Status Report on A18 Long-Term Operations.
Appendix 7. Poster Presentation at 2007 Estuarine Research Federation Conference in Providence, RI.

I. Introduction

This report summarizes the results of the 2007 water quality sampling conducted for Pond A18 in Santa Clara County. Monitoring activities occurred from May 1st through October 31st 2007. Sampling was performed by City of San Jose staff as required by the Waste Discharge Requirements of Order No. R2-2005-0003 (Order) issued on February 16, 2005 by the San Francisco Bay Regional Water Quality Control Board (Regional Water Board).

This was the third year of monitoring following initial release of water from Pond A18 on February 17, 2005 and the beginning of Continuous Discharge Operations on May 10, 2005. Adaptive management of Pond A18 included measures begun in 2005 to minimize the impact of low dissolved oxygen discharges on the immediate receiving water in Artesian Slough. Gate opening and closing procedures were streamlined in 2006 in an effort to improve communications with personnel at the San Jose/Santa Clara Water Pollution Control Plant (Plant), increase efficiency and minimize pond closures to maintain in-pond water quality and maximize flow through the pond. This was consistent with the recommendations in the 2005 Annual Self Monitoring Program Report for Pond A18 based on observations and conclusions as a result of the 2005 monitoring effort. The streamlined gate operations procedures implemented in 2006 were again used in 2007 resulting in similar levels of success.

In 2006 and 2007 the City voluntarily performed additional monitoring in an effort to gain a better understanding of pond dynamics. This supplemental monitoring included sampling of nutrients, mercury/methyl mercury, suspended solids and additional chlorophyll *a* sampling at several pond sites. A portion of the monitoring and analysis was conducted in a collaborative effort with the U.S. Geological Survey (USGS) in Menlo Park, CA. This collaboration with USGS resulted in an estimation of the Pond's primary production based on high resolution DO time series and correlations between shifts in pond water quality dynamics and variables such as irradiance and temperature. This additional analysis was presented at a scientific conference in November 2007 and will result in a future publication in a peer reviewed journal.

As in 2006, the City maintained regular communications (approximately weekly) with the Regional Water Board and U.S. Fish and Wildlife Service (USFWS). Ponds A16 and A17 are managed by USFWS and are located on the opposite side of Artesian Slough from A18. Pond A16 also discharges into Artesian Slough. The improved communication with these two resource agencies during the monitoring season was beneficial in sharing of data and management strategies. Weekly data sharing continued in 2007 and City staff attended one meeting to discuss data, pond performance, and reporting with Regional Water Board, USFWS, and Department of Fish and Game staff. Appendix 5 contains a summary of 2007 communications related to management of Pond A18.

The City contracted with H.T. Harvey and Associates to develop an Opportunities and Constraints report for potential future uses of A18. This report is complete and will be used in the planning process for A18 that is part of the overall Master Planning process for the San Jose/Santa Clara Water Pollution Control Plant (Plant). Provision 6 of the Order requires a status report on the long-term operation plans for Pond A18. The status report is in Appendix 6.

Figure 1 shows A18 with its intake and discharge structures and sampling sites in the pond and receiving water.

A. Waste Discharge Requirements

The discharge limitations for Pond A18 consist of the following three requirements taken from the Order:

1. Salinity, dissolved oxygen, and pH requirements as shown in Table 1.

Table 1. Pond A18 Discharge Requirements

Constituent	Instantaneous Maximum	Instantaneous Minimum	Units
Salinity for continuous circulation	44		ppt
Dissolved Oxygen[1]		5.0	mg/L
pH[2]	8.5	6.5	

[1] The Discharger may select discharge station A-A18-D, or receiving water station A-A18-5 to evaluate compliance with the dissolved oxygen limitation. In cases where receiving waters do not meet the Basin Plan objective, the Discharger must show, as described in its Operations Plan, that pond discharges do not further depress the dissolved oxygen level in the receiving water.

[2] The Discharger may select discharge station A-A18-D, or receiving water monitoring A-A18-5 to evaluate compliance with the pH limitation.

2. Pond waters discharging to Artesian Slough shall not exceed the natural temperature of the receiving waters by 20°F, or more.

3. Dissolved Oxygen Trigger. The Discharger shall monitor, report, and take corrective action measures, in accordance with the Operations Plan required by Provision D.2, if dissolved oxygen levels in Pond A18 at station A-A18-M fall below 1.0 mg/L during the continuous circulation period [note: the Regional Water Board has allowed the City to monitor A-A18-M at the discharge (D in Figure 1)].

B. Monitoring Requirements

Monitoring requirements for the continuous circulation period are described in Table 2.

Table 2. Continuous Circulation Monitoring for Pond A18

Sampling Station:	D.O.	pH	Temp	Salinity	Turbidity	Chlorophyll *a*	Metals/Water Column	Sample Function
A-A18-M	A	A	A	A		A		Management
A-A18-D	B	B	B	B			C **[eliminated for 2006]**	Discharge
A-A18-1	D	D	D	D	D			Receiving Water
A-A18-2	D	D	D	D	D			Receiving Water
A-A18-3	D	D	D	D	D			Receiving Water
A-A18-4	D	D	D	D	D			Receiving Water
A-A18-5	E	E	E	E				Receiving Water

LEGEND FOR TABLE 2

A = Monitoring shall be conducted within Pond A18 monthly from May through October. Dissolved oxygen monitoring shall be conducted between 0800 and 1000 hours. Time of monitoring shall be reported. [Note: this can be taken at D].

B = Discharge monitoring shall be conducted before pond water mixes with receiving water using a continuous monitoring device from May through October. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.

C = Water column samples for total and dissolved arsenic, chromium, nickel, copper, zinc, selenium, silver, cadmium, lead, and mercury shall be collected annually in August or September. When collecting metals samples, the Discharger shall also monitor for salinity, and total suspended solids. **[Note: This requirement was eliminated by the Regional Water Board in 2006 in a revision to the SMP included in a letter to the City dated May 9, 2006.].**

D = Receiving water monitoring shall be conducted at discrete locations from downstream to upstream monthly from May through October. The positions indicated on Figure 1 should be considered approximate. For days it monitors receiving water, the Discharger shall also (1) document if it monitors at flood tide, ebb tide, or slack tide (samples shall be collected as close to low tide as practicable), (2) monitor receiving water for dissolved oxygen, pH, temperature, salinity, and turbidity near the water surface and bottom, and (3) report standard observations, as described in Section D of the SMP.

E = Receiving water continuous monitoring for the purposes of determining compliance with the dissolved oxygen and pH limits shall be conducted from May through October at a location selected by the Discharger and approved by the Executive Officer at a point downstream of the discharge. Downtime of continuous monitoring devices shall be minimized to the maximum extent feasible, and addressed annually in the Discharger's Operations Plan.

In addition to the monitoring requirements listed in the table above, annual sampling for Pond A18 sediment mercury and methyl mercury is required in August or September of each year.

II. Methods and Results

This section summarizes the monitoring activities performed during the 2007 calendar year at Pond A18 to comply with the Order.

A. Quality Assurance/Quality Control

Instruments used for sampling A18 were calibrated and maintained to ensure accurate data. Sonde units (continuous and discrete water quality monitors) were calibrated for dissolved oxygen, pH and conductivity prior to deployment. Continuous sondes were cleaned and calibrated weekly unless additional maintenance was required. The discrete sonde unit was cleaned and calibrated prior to each use. A post-deployment calibration verification was performed on all sonde units after each use.

Data Validation

As part of the Quality Control program, a target range of values acceptable was determined for pH, dissolved oxygen and conductivity prior to initiation of dry-season monitoring. During the post-deployment calibration check, if a sonde unit's readings fell outside the specified range for a given parameter, the weekly data collected for that parameter was considered invalid for that week and was not reported.

Dissolved oxygen was calibrated using percent saturation in either water saturated air or air saturated water (theoretical reading of 100% saturation). Weekly data with post-deployment readings within ±10% of the theoretical saturation level were accepted. Data with readings greater than ±10 but that did not exceed ±15% of theoretical were accepted or rejected based on best professional judgment. If an instrument had a post-deployment dissolved oxygen reading that exceeded ±15% of theoretical, all dissolved oxygen data since the instrument's last calibration was rejected as invalid.

Calibrations for pH were performed using a 2-point calibration (pH 7 and pH 10 buffers) to establish a pH slope. Calibrations for conductivity were performed using either a 10,000 microSieman or a 50,000 microSieman standard. Post-deployment calibration verifications for pH and conductivity were performed using the same standards. For both parameters, a target range within ±5% of the theoretical was established to determine data validity. Data were considered invalid when post-deployment verifications fell outside 5% of the theoretical measurement for pH or conductivity.

Three post-deployment verification failures occurred during 2007, one each for dissolved oxygen, pH and conductivity. These occurred on the same instrument that was deployed at the discharge point in Pond A18 and appeared to be the result of an electrical malfunction of the unit. After the sonde unit in question failed the post-deployment verification for all parameters, it was taken out of service and scheduled for maintenance with the manufacturer. The single failure event in 2007 represents a significant improvement over the seven QA/QC failures from 2006 when eight separate failure events occurred resulting in lost data from 10 weekly parameter data sets. No QC failures occurred for discrete monitoring in 2007.

For the 2007 monitoring season, the post-deployment measurement error for reported water quality parameters was in the following ranges:

1. For dissolved oxygen: –5.7% to +2.6% (median -0.1%)
2. For pH: –1.6% to +4.7% (median +0.6%)
3. For conductivity: –4.4% to +2.6% (median -0%)

Reliable Oxygen (ROX™) probe

In 2006, six of the Quality Control failures were due to erroneous dissolved oxygen readings. In an effort to address this issue, the City invested in an equipment upgrade in August, 2006. The City purchased two new Reliable Oxygen (ROX™) probes, which were a new product by YSI[1] Environmental. The ROX™ probes utilize luminescent technology to measure dissolved oxygen levels more accurately and with reduced drift compared to the older membrane technology probes that were being used on all City-owned sonde units at the time. This investment in ROX™ probe technology resulted in no further Quality Control failures for dissolved oxygen for the remainder of the 2006 monitoring season.

Due to the success of the ROX™ probes in 2006, the City purchased three additional ROX™ probes from YSI Environmental, upgrading all City-owned YSI continuous sonde units to dissolved oxygen probes using luminescent technology. Implementing the use of ROX™ probes for continuous dissolved oxygen measurements resulted in no Quality Control failures for dissolved oxygen due to probe malfunction in 2007. The only invalid dissolved oxygen data for 2007 occurred as a result of an entire sonde unit malfunctioning during a weekly deployment.

B. Continuous Monitoring

Receiving water in Artesian Slough (station 5) and Pond A18 discharge (station D) were monitored continuously for temperature, practical salinity, pH, and dissolved oxygen during the dry season from May 1 to October 31, 2007 (Figure 1). Monitoring equipment consisted of YSI model 6600 sonde units fitted with the appropriate sensors. This equipment was chosen for its accuracy and reliability in monitoring dissolved oxygen concentrations in environments having variable salinities and biological fouling. As in 2006, City staff maintained a rigorous cleaning and maintenance schedule of this normally reliable equipment. The problems with dissolved oxygen measurements encountered in the early part of 2006 were corrected in 2007 by installation of state-of-the-art, luminescent-based dissolved oxygen sensors (ROX™) on all continuous sonde units. The equipment upgrades prevented any loss of dissolved oxygen data due to equipment fouling or probe failure.

Sonde units were cleaned, serviced, calibrated, deployed, and retrieved on a weekly basis. Water quality was measured and recorded every 15 minutes. Following retrieval from the field, data was downloaded to a computer, validated, summarized, and evaluated with respect to discharge requirements and action triggers. Discharge gate opening and closing times for the upcoming week were determined using best professional judgment and evaluating weekly 10th percentile

[1] YSI, Inc., 1725 Brannum Lane, Yellow Springs, Ohio 45387

dissolved oxygen readings for the pond discharge. Weekly data summaries were reported to Regional Water Board staff immediately (usually Tuesday or Wednesday) and adaptive management changes were shared with the appropriate Plant staff.

Temperature

Water temperature in the receiving water (Station 5; Figure 1) and at the A18 discharge gate (Station D), under both discharge and non-discharge conditions for 2007, are shown in Table 3. Pond and receiving water temperatures tended to increase during the four months of the monitoring season and decrease during the last two months of the season (Figure 3; Appendix 3).

Table 3. 2007 Continuous Temperature Monitoring Results (ºC)

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	20.4	29.3	25.0	25.1	17,648
A18 Discharge	15.4	29.3	22.9	23.3	12159
A18 Non-Discharge	15.4	29.2	21.9	22.4	4798

The Order requires that discharges comply with the State's Thermal Plan. The Plan specifies that discharges shall not exceed the natural temperature of receiving waters by 20°F (approximately 11ºC) and shall not cause temperatures to rise greater than 4°F above the natural temperature of the receiving water at any time or place. To evaluate compliance, receiving water temperatures were compared to Pond A18 temperatures for times when the pond was discharging (i.e. non-discharge periods were excluded from this comparison). Differences for each concurrent 15-minute monitoring interval were determined by subtracting each discharge temperature from the corresponding receiving water temperature. Negative results indicate that the receiving water temperature was higher and positive results indicate that the pond discharge temperature was higher (Figure 4). Temperature differences ranged from -7.2 to 5.1ºC and averaged -1.5 ºC over some 2,342 hours of discharge. On average, pond temperatures were lower than receiving water temperatures (Figures 3 & 4). At no time was the temperature of the pond discharge greater than 11ºC above the corresponding receiving water temperature (Figure 4; Appendix 3).

Pond temperatures at the discharge gate varied little between discharge and non-discharge periods (Table3; Figure 3).

Salinity

Salinity of the receiving water (Station 5; Figure 1) and of pond water at the A18 discharge gate (Station D), under both discharge and non-discharge conditions for 2007 are shown in Table 4. Discharge salinity remained below 40 ppt at all times during the 2007 monitoring period (Table 4).

Table 4. 2007 Continuous Salinity[2] Monitoring Results (PSU[2])

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	0.7	14.9	2.5	2.1	17648
A18 Discharge	16.4	30.1	23.8	24.4	12159
A18 Non-Discharge	16.5	30.1	27.1	27.8	4798

Salinity increased in Pond A18 until the last week of September, at which point pond salinity steadily decreased until the end of the monitoring season. Salinity in the receiving water increased steadily throughout the season (Figure 5; Appendix 3) with periodic salinity spikes corresponding to incoming tides (Figure 7). These increases in both the receiving water and pond were likely due to low freshwater tributary flows and high rates of evaporation during the summer months. Decreases in pond salinity in the fall (Figure 5; Appendix 3) are likely due to decreased solar evaporation due to shorter day length, increased cloud cover and occasional rain events.

pH

The pH of the receiving water (Station 5; Figure 1) and of pond water at the A18 discharge gate (Station D), under both discharge and non-discharge conditions for 2007, are shown in Table 5. Pond pH levels were higher and more variable over the entire season than pH levels in the receiving water (Figure 6; Appendix 3). Shorter-term, diurnal fluctuation of pH, which were much stronger in the receiving water (Figure 6; Appendix 3), appear to reflect the daily salinity changes resulting from the natural tidal cycle (Figure 7).

Table 5. 2007 Continuous pH Monitoring Results

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	7.0	8.4	7.3	7.3	17648
A18 Discharge	8.2	9.9	8.9	8.8	12159
A18 Non-Discharge	8.2	9.8	8.7	8.6	4798

The Order requires that the pH objective of 6.5 to 8.5 be met either in the discharge or in the receiving water. During 2007 operations, pH in the receiving water was never outside of this range specified in the Basin Plan Objectives. Therefore, all requirements from the Order with respect to pH were met for the entire 2007 dry season. Similar to 2006, pond pH in 2007 remained elevated (≥8.2 at all times) during the summer months. Despite the relatively elevated pH levels in the pond, and increased pond discharge time in 2007 compared to the previous two years, there was no noticeable effect on the pH of the receiving water (Figure 6; Appendix 3) due

[2] Practical Salinity Units (PSU) are a measurement of salinity from the specific conductance measured in water. An algorithm based on the ion composition of natural sea water converts specific conductance into PSU. One PSU is approximately equivalent to one part-per-thousand salinity.

to Pond A18 discharges. It is also interesting to note that pond pH levels in the early part of 2007 were similar to those measured throughout 2006 with pond pH consistently at or above 9. However, by the last week of June 2007, pH levels in Pond A18 had decreased approximately 0.3 units on average and were consistently between 8.5 and 8.8 until the end of the monitoring season.

Dissolved Oxygen

Dissolved oxygen concentrations in the receiving water (Station 5; Figure 1) and in pond water at the A18 discharge gate (Station D), under both discharge and non-discharge conditions for 2007 are shown in Table 6. Finer scale weekly dissolved oxygen concentrations are shown graphically in Appendix 1.

Table 6. 2007 Continuous Dissolved Oxygen Monitoring Results

Site/Condition	Minimum	Maximum	Mean	Median	# of Measurements (n)
Artesian Slough	4.6	10.2	6.9	6.9	17648
A18 Discharge	0.0	17.9	7.3	7.4	12159
A18 Non-Discharge	0.0	15.0	4.9	4.6	4798

Dissolved oxygen (DO) levels in the receiving water fell below the Basin Plan objective of 5 mg/L three times during the 2007 monitoring season. On July 5th, for a 30-minute period beginning at 2:30a.m., the DO at station 5 in Artesian Slough was 4.9 and 4.8 mg/L. Pond A18 was discharging at the time (average flow during the 30-minute period was 16.7 cfs) with corresponding DO concentrations of 6.5 and 6.4 mg/L. On August 1st, DO in Artesian Slough was 4.8 and 4.9 mg/L for a 30-minute period beginning at 12:30a.m. Pond A18 was discharging at the time (average flow during the 30-minute period was 24.5 cfs) with corresponding DO concentrations of 3.2 and 2.8 mg/L. The final incident occurred over a 45-minute period on August 2nd beginning at 1:15a.m. Receiving water DO during this time was 4.6 – 4.8 mg/L. Pond A18 was discharging at the time (average flow during the 45-minute period was 26.3 cfs) with DO concentrations of 3.2 – 3.7 mg/L. All three incidents were reported to the Regional Water Board and corrective action was taken as a result of the August 1st and 2nd incidents.

Weekly measurements of Pond A18 DO levels, during both discharge and non-discharge periods, were plotted alongside Artesian Slough DO levels to evaluate the effect of the discharge, if any, on DO levels in the receiving water (Appendix 1, Weeks 1-26).

Weekly 10th percentile DO values were calculated for the pond's discharge and reported to the Regional Water Board (Table 7). The order requires implementation of adaptive management (corrective action) whenever weekly 10th percentile DO values fall below 3.3 mg/L. There were a total of 6 weeks (evaluated Tuesday to Tuesday) during which pond discharge DO levels fell below the weekly 10th percentile trigger of 3.3 mg/L. In contrast to 2006, when 7 trigger incidents occurred in the first half of the season, all 6 trigger incidents in 2007 occurred from the middle of July and later. The adaptive management used to address low pond DO levels was to close the discharge gate 6-12 hours per day (Table 7). Pond DO concentrations exhibited a strong diurnal pattern, with high (supersaturated) DO in the afternoon and evening and low DO during the early morning hours (Appendix 1). Therefore, gate closings were always scheduled during the early morning hours (e.g. 2:00 – 10:00 a.m.). Comparisons of mean DO during discharge versus non-discharge (Table 6) indicate that this strategy was effective in limiting the discharge of lower DO pond water.

General Observations

On the morning of September 4, 2007, during the weekly retrieval and deployment of sonde units, hundreds of stickleback fish were observed in Pond A18 floating near the surface of the pond discharge. The fish appeared to be lethargic and stressed but no dead fish were observed. Approximately 3000 California gulls, 200 brown pelicans and 30 terns were foraging on the stressed fish at the discharge point. Winds were breezy (3-5 mph) out of the northeast, which likely blew biota to the southwest corner of the pond where the discharge point is located. Dissolved oxygen concentrations in the pond were at or below 1.0 mg/L since 4:45am on 9/4/07 and remained low several hours up to and including 10:00am when the observation was made (See Appendix 1, weeks 18 and 19). The observation was reported to the Regional Water Board via email (Appendix 5).

Pond water color and clarity changed throughout the monitoring season. Initially the pond was relatively clear compared to previous years and had a brownish color. As the monitoring season progressed, water clarity declined and the pond color became greenish brown by mid-July and was green with some brown by the end of the monitoring season.

Filamentous macro-algae were more prevalent in 2007 than in previous years. During the beginning (May and June) of the monitoring season, algal mats covered from 15 – 40% of the surface of the pond. These large floating mats decreased as the season continued, with all filamentous algae absent from the pond surface by late September, 2007. As these mats die, sink and decay, they may contribute to decreased dissolved oxygen levels in the pond due to increased decomposition rates. The City updated the Regional Water Board regarding the amount of visible macro-algae in Pond A18 via weekly email correspondence (Appendix 5).

There were no other unusual observations, odors or occurrences during continuous monitoring.

Table 7. Weekly 10th Percentile Dissolved Oxygen (DO) Concentrations (mg/L) for Pond A18 Discharge during the 2007 Monitoring Season. * Indicates values below the weekly trigger value of 3.3 mg/L. Gate Status/Corrective Action Column reflects action that was applied to the following week.

Discharge Period	10th Percentile DO (mg/L)	Gate Status/Corrective Action
May 1st through 8th	7.3	Discharge Gate fully open.
May 8th through 15th	8.3	Discharge Gate fully open.
May 15th through 22nd	7.8	Discharge Gate fully open.
May 22nd through 29th	5.8	Discharge Gate fully open.
May 29th through June 5th	6.5	Discharge Gate fully open.
June 5th through 12th	6.9	Discharge Gate fully open.
June 12th through 19th	4.8	Discharge Gate fully open.
June 19th through 26th	5.0	Discharge Gate fully open.
June 26th through July 3rd	5.5	Discharge Gate fully open.
July 3rd through 10th	4.1	Discharge Gate fully open.
July 10th through 17th	2.6*	Close Discharge Gate 6 hours per day during low DO periods.
July 17th through 24th	3.3	Continue 6 hour/day Gate Closure.
July 24th through 31st	2.3*	Increase Discharge Gate Closure to 8 hours per day.
July 31st through August 7th	3.3	Increase Discharge Gate Closure to 9 hrs/day due to Receiving Water DO below 5.0.
August 7th through 14th	3.8	Continue 9 hour/day Gate Closure
August 14th through 21st	6.0	Decrease Discharge Gate Closure to 8 hours per day.
August 21st through 28th	5.9	Continue 8 hours/day Gate Closure during low DO periods.
August 28th through September 4th	5.1	Continue 8 hours/day Gate Closure during low DO periods.
September 4th through 11th	1.8*	Increase Discharge Gate Closure to 10 hours per day.
September 11th through 18th	7.7	Decrease Discharge Gate Closure to 8 hours per day
September 18th through 25th	2.5*	Increase Discharge Gate Closure to 11 hours per day
September 25th through October 2nd	1.3*	Increase Discharge Gate Closure to 12 hours per day.
October 2nd through 9th	No Data (Sonde failure)	Continue 12 hours/day Gate Closure during low DO periods.

Table 7 (continued). Weekly 10th Percentile Dissolved Oxygen (DO) Concentrations (mg/L) for Pond A18 Discharge during the 2007 Monitoring Season. * Indicates values below the weekly trigger value of 3.3 mg/L. Gate Status/Corrective Action Column reflects action that was applied to the following week.

Discharge Period	10th Percentile DO (mg/L)	Gate Status/Corrective Action
October 9th through 16th	6.7	Decrease Discharge Gate Closure to 8 hours per day.
October 16th through 23rd	2.4*	Increase Discharge Gate Closure to 9 hours per day.
October 23rd through 31st (8 days)	6.5	End of Monitoring Season

C. Discrete Monitoring

In addition to continuous water quality monitoring at the A18 discharge and in the receiving water, the Order requires discrete monthly sampling of water quality at four receiving water locations (Figure 1) during the monitoring season (Table 2). Although the Order required monitoring water quality parameters (temperature, salinity, DO, & pH) at the surface and bottom only, the entire water column was monitored at 1-foot intervals (Appendix 2). The surface and bottom measurements are summarized in Table 8. The depth profiles of water quality in Artesian Slough help describe the mixing of fresh slough water with salt water from the Bay during tidal exchange. Measurements were taken as close to low tide as practical and while Pond A18 was discharging, as required by the Order. The City deliberately attempted to conduct this discrete monitoring so that both ebbing and flooding tide profiles were captured.

An additional discrete monitoring event occurred on 10/16/07 during a flooding tide while the pond was not discharging (Table 9). The event was not planned as a non-discharge sampling event, but due to a Plant staff delay in opening the discharge valve on 10/16/07, the discrete monitoring was conducting while the discharge gate was still closed. This occurrence was somewhat fortuitous because discharge from Pond A18 had been ceased for more than 12 hours prior to the 10/16/07 monitoring so surface and bottom water quality are representative of the Artesian Slough water column transect profile independent of Pond A18 discharge influence.

Table 8. Monthly Surface and Bottom Water Quality Measurements in Artesian Slough.

Date and Time	Site	Tide	Depth	Temp (C)	Salinity (PSU)	pH	D.O. (mg/L)	Turbidity (NTU)	A18 Flow (cfs)
5/29/07 11:10	1	Flood	Bottom	22.5	8.8	8.4	8.8	2.8	22.1
5/29/07 11:11	1	Flood	Surface	24.1	8.7	7.5	8.7	2.4	22.1
6/19/07 11:28	1	Low	Bottom	25.0	7.8	7.8	8.1	5.5	41.1
6/19/07 11:30	1	Low	Surface	25.2	1.2	7.6	8.7	3.4	41.1
7/17/07 12:05	1	Flood	Bottom	26.2	0.6	7.6	9.9	5.6	39.6
7/17/07 12:06	1	Flood	Surface	26.3	0.6	7.4	10.2	9.8	39.6
8/15/07 11:59	1	Flood	Bottom	24.4	18.6	7.4	7.2	4.0	66.0
8/15/07 12:01	1	Flood	Surface	26.5	0.7	8.3	7.7	3.0	66.0
9/26/07 10:45	1	Ebb	Bottom	22.5	19.9	8.3	6.0	12.4	44.2
9/26/07 10:49	1	Ebb	Surface	26.0	0.7	7.4	7.3	2.3	44.2
10/29/07 12:35	1	Flood	Bottom	21.2	17.2	8.3	8.1	12.0	17.9
10/29/07 12:38	1	Flood	Surface	24.8	0.6	7.5	7.2	2.7	14.6
5/29/07 10:18	2	Flood	Bottom	22.8	4.2	7.7	6.3	8.6	27.6
5/29/07 10:20	2	Flood	Surface	23.6	2.1	7.5	7.9	2.7	27.6
6/19/07 11:20	2	Ebb	Bottom	24.9	6.5	8.1	8.1	23.2	40.8
6/19/07 11:21	2	Ebb	Surface	25.7	2.8	7.7	8.5	5.8	40.8
7/17/07 11:57	2	Flood	Bottom	25.4	9.1	8.0	7.5	34.5	39.6
7/17/07 11:58	2	Flood	Surface	26.1	2.4	7.8	8.6	5.6	39.6
8/15/07 11:42	2	Flood	Bottom	25.2	12.0	7.4	6.6	16.6	68.0
8/15/07 11:43	2	Flood	Surface	26.2	4.1	7.6	7.6	2.5	68.0
9/26/07 10:35	2	Ebb	Bottom	23.0	14.5	8.1	6.7	13.9	47.6
9/26/07 10:38	2	Ebb	Surface	25.5	2.1	7.5	7.4	5.6	44.2
10/29/07 12:27	2	Flood	Bottom	20.8	19.0	8.4	7.1	8.3	17.9
10/29/07 12:29	2	Flood	Surface	23.9	2.6	7.5	6.9	4.4	17.9
5/29/07 10:55	3	Flood	Bottom	20.8	8.1	7.6	4.6	26.0	23.4
5/29/07 10:58	3	Flood	Surface	22.8	3.3	7.5	7.1	14.0	23.4
6/19/07 10:58	3	Ebb	Bottom	24.8	4.4	7.6	6.8	38.4	40.6
6/19/07 11:00	3	Ebb	Surface	24.9	4.5	7.5	7.0	24.5	40.6
7/17/07 11:45	3	Flood	Bottom	25.8	5.6	7.6	7.5	56.1	40.3
7/17/07 11:45	3	Flood	Surface	25.9	5.5	7.6	7.6	32.7	40.3
8/15/07 11:31	3	Flood	Bottom	26.2	3.3	7.5	6.3	38.3	70.0
8/15/07 11:32	3	Flood	Surface	26.5	3.3	7.4	6.6	19.3	70.0
9/26/07 10:19	3	Ebb	Bottom	24.0	5.1	7.5	4.9	59.5	50.8
9/26/07 10:27	3	Ebb	Surface	24.2	5.1	7.4	4.9	41.5	47.6
10/29/07 11:57	3	Flood	Bottom	21.4	11.9	7.5	2.8	10.6	28.3
10/29/07 12:01	3	Flood	Surface	22.9	4.9	7.4	5.7	6.8	28.3
5/29/07 10:38	4	Flood	Bottom	20.6	13.4	7.9	4.3	54.0	25.0
5/29/07 10:42	4	Flood	Surface	20.6	13.4	7.9	4.4	39.0	25.0
6/19/07 10:48	4	Ebb	Bottom	24.4	3.6	7.3	4.9	412	40.1
6/19/07 10:49	4	Ebb	Surface	24.5	3.8	7.3	5.3	171	40.1
7/17/07 11:34	4	Low	Bottom	25.3	5.9	7.4	6.1	54.5	41.1
7/17/07 11:36	4	Low	Surface	25.7	5.9	7.4	6.2	49.2	41.1
8/15/07 11:17	4	Flood	Bottom	23.3	13.4	7.0	4.0	118.0	71.9
8/15/07 11:19	4	Flood	Surface	24.3	9.1	7.3	4.1	27.3	71.9
9/26/07 10:07	4	Ebb	Bottom	20.8	13.0	7.6	2.6	82.5	50.8
9/26/07 10:08	4	Ebb	Surface	21.0	12.6	7.6	2.6	42.0	50.8
10/29/07 11:41	4	Flood	Bottom	18.9	15.0	7.6	4.0	56.0	32.6
10/29/07 11:44	4	Flood	Surface	19.4	14.2	7.7	4.3	30.3	32.6

Table 9. October 16, 2007 Surface and Bottom Water Quality Measurements in Artesian Slough While Pond A18 Was Not Discharging.

Date and Time	Site	Tide	Depth	Temp (˚C)	Salinity (PSU)	pH	DO (mg/L)	Turbidity (NTU)	A18 Flow (cfs)
10/16/07 14:46	1	Flood	Bottom	19.9	17.6	8.1	3.6	8.5	0.0
10/16/07 14:43	1	Flood	Surface	24.2	1.3	7.5	6.9	2.0	0.0
10/16/07 14:37	2	Flood	Bottom	19.7	17.2	7.9	5.0	11.2	0.0
10/16/07 14:33	2	Flood	Surface	23.9	1.7	7.5	6.8	2.6	0.0
10/16/07 14:24	3	Flood	Bottom	20.6	14.7	7.9	2.6	19.4	0.0
10/16/07 14:20	3	Flood	Surface	22.7	2.8	7.7	5.0	3.5	0.0
10/16/07 14:07	4	Flood	Bottom	17.3	18.3	7.8	4.6	26.1	0.0
10/16/07 14:00	4	Flood	Surface	17.6	15.6	7.8	4.7	26.8	0.0

Pond A18 discharge valve was closed at 2:00am on 10/16/07 as part of the adaptive management process in response to triggering due to overnight low dissolved oxygen in Pond A18 discharge. The pond had not been discharging for more than 12 hours when this sampling was conducted.

Temperature, salinity, pH, dissolved oxygen, and chlorophyll *a* were measured monthly in the A18 discharge, as required by the Order (indicated by "A" in Table 2). The Order requires that the discrete dissolved oxygen measurement be taken between 0800 and 1000 hours. Results reported below were taken from the continuous discharge monitor for the date and time of the Pond A18 chlorophyll *a* sample collection, which also occurred between 0800 and 1000 hours (Table 10).

Table 10. Monthly Water Quality Measurements Taken at the A18 Discharge

Date and Time	Temperature (C)	Salinity (PSU)	pH	Dissolved Oxygen (mg/L)
5/29/2007 09:30	21.65	19.10	8.9	6.1
6/19/2007 09:15	24.46	21.48	8.9	4.3
7/17/2007 09:45	23.44	25.02	8.5	2.4
8/15/2007 09:30	22.65	27.88	8.6	5.4
9/26/2007 09:00	20.51	29.92	8.5	3.2
10/16/2007 09:15	17.29	27.49	8.4	3.3

Temperature

Water temperatures in Artesian Slough tended to decrease in a downstream direction. As expected, temperatures also tended to decrease with depth (Tables 8 and 9; Appendix 2).

Pond A18 temperature is influenced by ambient air temperature and varied as expected for a large shallow, limited flow waterbody throughout the monitoring season (Table 10).

Salinity

Vertical profiles of salinity were taken monthly at four stations in Artesian Slough (Figure 1; Appendix 2). These profiles indicate that receiving water is fairly well mixed at stations 4 and often at station 3 but that significant depth-related salinity differences can occur at stations 1 and 2 during flooding tides. For example, on August 15th, surface and bottom salinities, respectively, were 0.7 and 18.6 PSU (station 1), 4.1 and 12.0 PSU (station 2), 3.3 and 3.3 PSU (station 3), and 9.1 and 13.4 PSU (station 4). This pattern of salinity stratification and mixing during a flooding tide occurred regardless of whether Pond A18 was discharging or not (Table 9).

Pond A18 salinity gradually increased over the summer from about 19 PSU to a maximum of nearly 30 PSU in September (Table 10; Figure 5).

pH

Vertical profiles of pH were taken monthly at four stations in Artesian Slough (Figure 1; Appendix 2). Receiving water pH levels tended to be somewhat stratified at the upstream stations (stations 1 and 2) with bottom pH slightly higher than surface pH regardless of tidal stage or pond discharge status (Tables 8 and 9). Downstream receiving water stations (stations 3 and 4) were not stratified with respect to pH and appeared uniform throughout the water column.

Pond A18 pH levels (Table 10) were significantly higher than those of the receiving water (Table 8). This reflects the higher algal biomass and corresponding higher rates of photosynthesis in the pond (see chlorophyll *a* results below).

Dissolved Oxygen

Monthly vertical profiles of dissolved oxygen concentrations (DO) from the four Artesian Slough stations (Figure 1; Appendix 2) indicate that surface DO levels were higher than bottom DO levels (Figure 8), particularly at Station 2. While stations 1, 3 and 4 showed differences between surface and bottom DO levels, the differences are nominal and these stations on average appear vertically well mixed with respect to average DO concentrations. Surface DO levels declined from an average of 8.3 mg/L at station 1 to 4.5 mg/L at station 4. Bottom DO levels declined from an average of 8.0 mg/L at station 1 to 4.3 mg/L at station 4. Lower dissolved oxygen levels near the mouth of Artesian Slough compared to station 1 near the Pond A18 discharge are likely a result of two factors. First, the solubility of oxygen decreases as salinity increases. Due to tidal influence in Artesian Slough, salinity increases in a downstream direction resulting in lower oxygen solubility further downstream. Second, the Plant discharge has relatively high DO (≅7 mg/L) and the proportion of effluent in Artesian Slough (an effluent dominated channel) is greater at station 1 than at station 4.

The Order requires the discharger to monitor, report, and take corrective action if monthly discrete dissolved oxygen levels in Pond A18, taken between the 800 and 1000 hours at station A-A18-M [can be taken at station D], fall below 1.0 mg/L. Since monthly discrete dissolved oxygen levels did not fall below 1.0 mg/L during this monitoring in 2007 (Table 10), no corrective action was required as a result of the early morning discrete pond dissolved oxygen trigger of 1.0 mg/L.

Turbidity

Turbidity was measured monthly at four stations in Artesian Slough in 2006. Turbidity increased in a downstream direction from station 1 to station 4 (Figure 9). As expected, turbidity was greater at the bottom than at the surface at each station. Greater downstream turbidity, which was also observed in 2005 and 2006, was presumably due to the low TSS in the Plant's discharge and the greater effect of flooding tides on turbidity in the lower reaches of Artesian Slough.

General Observations

There were no unusual observations, odors or occurrences during discrete monitoring.

D. Sediment Monitoring

Two separate sediment monitoring requirements are specified in the Order: mercury and methyl mercury measurements from in-pond sediments and analysis of the benthic macro-invertebrate community from Artesian Slough sediment grabs. The requirement for analysis of the benthic macro-invertebrate community in Artesian Slough ended with the late-summer 2006 monitoring event. Therefore, only in-pond sediment monitoring for mercury and methyl mercury was performed in 2007. The Order states that sediment monitoring is to be performed in August or September of each year. Sediment monitoring for 2007 occurred on September 25, 2007.

Mercury/Methyl Mercury

Pond A18 sediment was sampled at four in-pond locations (Figure 1) on September 25, 2007 by Kinnetic Laboratories Inc (KLI) to determine concentrations of total mercury and methyl mercury. Sediment samples were also analyzed for pH, total organic carbon (TOC), total sulfides, redox potential and particle size distribution. Total mercury, methyl mercury and percent solids analyses were performed by BrooksRand in Seattle, WA. Analyses of pH, TOC, total sulfide, redox potential and particle size were performed by Columbia Analytical Services in Kelso, WA. In addition, temperature, dissolved oxygen, pH, salinity and redox potential were measured in the overlying water at each sampling station using the following meters:

- YSI Model 63 handheld instrument for temperature, pH and salinity
- YSI Model 58 portable meter for dissolved oxygen
- Oakton ORPtestr 10 meter for oxidation-reduction (redox) potential

Four sediment grab samples were collected at each of four sampling stations (16 separate grab samples), using either a pre-cleaned stainless steel petite ponar grab or a pre-cleaned stainless steel coring device. All samples were composited in their own pre-cleaned tefzel-coated compositing bucket. Very large chunks of gypsum and rock were removed during homogenization where possible. For core collected samples, the top (<5 cm) portion of each station's sub-samples were composited. Composited, homogenized samples were placed into appropriate sample containers provided by each analytical laboratory.

Composited samples were immediately placed on ice and shipped overnight to the appropriate analytical laboratories. Details of the analytical methods utilized by BrooksRand and Columbia Analytical services, QA/QC results and calibration of the YSI sonde are reported in Appendix 3.

Complete results of the Pond A18 annual sediment mercury analysis are summarized in Table 1 of Appendix 3. Total mercury in sediment samples ranged from 66 to 512 ng/g dry weight. This is less than the USEPA criteria for total mercury in sediment of 1000 ng/g dry weight. Methyl mercury in sediment samples ranged from 0.149 to 3.807 ng/g dry weight. Pond A18 mercury and methyl mercury concentrations in sediment for 2007 were greater than those measured in 2006 for most stations. After three years of mercury and methyl mercury monitoring of Pond A18 sediments, concentrations show high inter-annual and spatial variability even when normalized to percent clay (Table 11). While spatial patterns may exist in a given year, such as uniform concentrations of both total mercury and methyl mercury in the upper 5 cm of pond sediment north to south in 2006, these patterns have not been consistent from year to year.

Table 11. Comparison of 2005, 2006 and 2007 sediment mercury and methyl mercury results from four locations in Pond A18, including values normalized to percent clay. Station A18-1 is the most southern station and A18-4 is the most northern station.

Year	Analyte	A18-1	A18-2	A18-3	A18-4
2005	Total Hg (ng/g)	195	233	220	307
	Me Hg (ng/g)	0.421	0.638	2.095	3.373
	Percent Clay (%)	32.7	22.5	16.7	13.4
	Hg normalized (ng/g)	504	1036	1317	2291
	Me Hg normalized (ng/g)	1.088	2.836	12.545	25.172
2006	Total Hg (ng/g)	177	304	119	110
	Me Hg (ng/g)	0.305	0.253	0.353	0.282
	Percent Clay (%)	44.5%	39.7%	21.9%	23.2%
	Hg normalized (ng/g)	398	765	543	474
	Me Hg normalized (ng/g)	0.685	0.637	1.612	1.216
2007	Total Hg (ng/g)	304	512	66	216*
	Me Hg (ng/g)	0.149	0.155	0.184	3.807*
	Percent Clay (%)	11.4%	16.3%	7.84%	25.0%*
	Hg normalized (ng/g)	2667	3141	842	864*
	Me Hg normalized (ng/g)	1.307	0.951	2.35	15.228

* Results from Station A18-4 are the mean of duplicate samples taken at this location. Duplicate samples from A18-4 were sent to analytical laboratories blindly as A18-4 and A18-5. See Appendix 3 for a discussion of the field duplicate sample.

E. Chlorophyll *a*

Chlorophyll *a* was measured on a monthly basis in Pond A18 at the pond discharge point. Once per month, a 1-liter grab sample was collected and placed in a 1-liter plastic jar. The sample was kept cool and out of direct light. Within 4 hours of collection, the sample was transferred to TestAmerica Analytical Testing Corporation in Morgan Hill, CA via courier. Analysis of all monthly chlorophyll *a* samples was performed by TestAmerica.

Chlorophyll *a* levels in Pond A18 peaked in the final two months of the monitoring season at 52 µg/L and 50 µg/L in September and October respectively (Table 12). Chlorophyll *a* increased in steadily in the pond throughout the monitoring season and was generally lower than during the previous two years. Qualitative, general observations taken weekly at the pond indicate a gradual increase in pond turbidity (i.e. observed opaqueness of the pond) throughout the season and a gradual color change from brown to green. These qualitative observations and the gradual increase in chlorophyll *a* indicate a likely change in the Pond's algal community.

Table 12. Results of monthly chlorophyll *a* measurements in Pond A18 at the discharge point. Salinity measurements are included for context as a potential causative factor of changes in chlorophyll *a*.

Month (2007)	Date sampled	Salinity (PSU)	Chlorophyll *a* (µg/L)
May	5/29/07	19.10	13
June	6/19/07	21.48	12
July	7/17/07	25.02	16
August	8/15/07	27.88	25
September	9/26/07	29.92	52
October	10/16/07	27.49	50

F. Phytoplankton Species Composition

An additional sample for phytoplankton species composition analysis was collected concurrently with the monthly pond chlorophyll *a* sample. This second sample is not required by the Order, but is a useful qualitative supplemental monitoring tool for detecting and describing changes in the pond's autotrophic community. The monthly phytoplankton sample was collected into a 125 mL plastic bottle, immediately preserved with lugols solution and archived in order to provide targeted opportunities to analyze the phytoplankton community structure during suspected periods of transition within the pond.

For 2007, the City had phytoplankton species composition analysis performed on samples collected in June, July, September and October to represent the range of early, transitional and late season community structure. In general, based on density (cells/mL), phytoplankton species data show that the dominant species was a filamentous cyanobacteria (*Anabaenopsis milleri*) in the early part of the monitoring season. The latter months were dominated by a solitary brackish diatom (*Cyclotella atomus*) that was not detected in June and in limited numbers in July

III. Exceedances and Triggered Actions

A. Summary of Exceedances and Triggers

Table 13 summarizes the exceedances, triggers and corrective actions taken for 2007. All incidents were reported to the Regional Water Board.

B. Summary of Corrective Action

There were three incidents where dissolved oxygen in the receiving water fell below the 5.0 mg/L Basin Plan Objective. All occurrences were brief (30 minutes), minor (receiving water DO never fell below 4.8 mg/L) and occurred in the early morning when DO is lower in natural systems because of lack of photosynthesis and increased net ecosystem respiration. The July 5th incident occurred for a thirty-minute period beginning at 2:30am, the August 1st incident occurred for a thirty-minute period beginning at 12:30am and the August 2nd incident occurred for a 45-minute period beginning at 1:15am. Pond A18 was discharging during all three events. The Order specifies that the 5.0 mg/L Basin Plan Objective for DO can be met either at the pond discharge point or in the receiving water. If the Objective is not met at both locations while the pond is discharging, then corrective action must be taken. Therefore, the incident on 7/5/07 with receiving water DO concentrations of 4.8 – 4.9 mg/L did not require corrective action since the corresponding DO in the pond discharge was 6.4 – 6.5 mg/L. Corrective action was taken as a result of the 8/1/07 and 8/2/07 incident (Table 13) since DO in both the receiving water (4.6 to 4.9 mg/L) and pond discharge (3.2 and 2.8 mg/L) were below 5.0 mg/L. Since the two August incidents occurred during the same week on consecutive days similar early morning hours, and both were discovered simultaneously during weekly sonde retrieval and data download on August 7, the corrective action taken addressed both incidents. Specifically, the gate discharge closure time was increased for the following week (8/7 – 8/14) so that the discharge gate was closed one-hour earlier (at 1:00am) than during the previous week.

There were 6 weeks in which the weekly 10th percentile DO level in the discharge fell below the established trigger of 3.3 mg/L (Table 13). Similar to what was done in 2005 and 2006, the corrective action following these trigger events was to close the discharge gate for varying periods of time during the night when DO levels were especially low. The closure time varied depending upon the magnitude and duration of low DO levels in the discharge (Table 13). This adaptive management was successful insofar as it maximized pond discharge time while minimizing discharges of overnight low DO water from A18. This resulted in fewer triggering incidents had pond discharges not been timed (Table 7).

Table 13: Pond A18 Exceedances of Water Quality Objectives & Trigger Levels and Corrective Action

Date	Water Quality Excursions from Basin Plan Objective	Corrective Action
7/5/07	DO in Artesian Slough was 4.8 – 4.9 mg/L for 30 minutes	None. Pond discharge DO was 6.5 mg/L and 6.4 mg/L for corresponding 30 minutes.
8/1/07	DO in Artesian Slough was 4.8 – 4.9 mg/L for 30 minutes	Increase Discharge Gate Closure from 8 to 9 hours.
8/2/07	DO in Artesian Slough was 4.9 – 4.8 mg/L for 45 minutes	Increase Discharge Gate closure from 8 to 9 hours.
Date	**Dissolved Oxygen Trigger**	**Corrective Action**
7/10 – 7/17/07	10th Percentile DO Concentration in the A18 discharge was 2.6 mg/L	Close Discharge Gate 6 hours per day during low DO periods
7/24 – 7/31/07	10th Percentile DO Concentration in the A18 discharge was 2.3 mg/L	Increase Discharge Gate Closure from 6 to 8 hours per day
9/4 – 9/11/07	10th Percentile DO Concentration in the A18 discharge was 1.8 mg/L	Increase Discharge Gate Closure from 8 to 10 hours per day
9/18 – 9/25/07	10th Percentile DO Concentration in the A18 discharge was 2.5 mg/L	Increase Discharge Gate Closure from 10 to 11 hours per day.
9/25 – 10/2/07	10th Percentile DO Concentration in the A18 discharge was 1.3 mg/L	Increase Discharge Gate Closure from 11 to 12 hours per day.
10/16 – 10/23/07	10th Percentile DO Concentration in the A18 discharge was 2.4 mg/L	Increase Discharge Gate Closure from 8 to 9 hours per day.

IV. Supplemental Monitoring

In an effort to increase our understanding of Pond A18 dynamics, the City initiated a supplemental monitoring program in September 2006. The monitoring required by the Order is focused on water quality of the water being discharged from Pond A18 and any potential impacts that discharge may have on Artesian Slough receiving water. The supplemental monitoring was intended to provide information regarding spatial variability within the pond or the extent of the influence intake water may be having within the pond. The supplemental monitoring program initiated by the City in 2006 is a first step in addressing some of these questions and should lead to a better understanding of Pond A18. This supplemental monitoring was done at the discretion of the City as staff time and budget allowed.

Supplemental monitoring results from 2006 were presented in the 2006 Annual Self-Monitoring Program Report for A18. Under the supplemental monitoring program in 2006, discrete water quality readings and grab samples for a suite of analytical measurements were taken at two receiving water locations and seven locations in Pond A18 (Figure 2). The monitoring results indicated that the pond is well-mixed and homogenous with regard to aqueous concentrations of TSS, phosphate, sulfate, chloride, organic carbon, mercury and methyl mercury. Discrete measurements of temperature, pH and salinity also showed no spatial variability in the pond.

Chlorophyll *a* measurements and supplemental monitoring of phytoplankton species composition performed in 2006 were useful in characterizing changes in the phytoplankton community in the pond. The large algal biomass and dynamic phytoplankton community structure in the pond results in a highly productive system but also one that is very sensitive to climatic perturbations such as prolonged periods of high temperatures or decreased solar irradiance.

Due to the lack of spatial variability in the pond as well as staff and budgetary constraints, the supplemental monitoring for 2007 was reduced. Additional monitoring beyond that required in the Order focused on the most useful information gathered during 2006 supplemental monitoring, which was tracking and characterizing changes in phytoplankton composition and algal biomass within the pond. The major results from this supplemental monitoring are presented in Section II.F of this report.

V. Discussion

This section discusses 2007 monitoring season results and observations and provides comparison with those of 2005 and 2006.

Temperature

Pond and receiving water temperatures observed in 2007 (Table 3) were very similar to those observed during 2006 and the 2005 Continuous Circulation Period. Unlike 2006, when pond temperatures reached very high levels for 2 weeks in July, there was not a prolonged period of very high ambient and pond temperatures in 2007 (Figure 3). As in previous years, average pond discharge temperatures were lower than receiving water temperatures in 2007 (Figure 4). Monthly comparisons of pond and receiving water temperatures are shown graphically in Appendix 4. While average temperatures were similar, it is important to note that temperatures in Pond A18 and the receiving water during 2007 monitoring did not reach the highs that occurred in 2006, due to the milder summer in 2007 compared to 2006. Prolonged hot weather can have negative effects on dissolved oxygen levels due to increased respiration rates.

Salinity

During three years of dry season monitoring for Pond A18, salinity has been the most variable water quality parameter measured in the pond both within and between years. In 2005, Pond A18 salinity was lowered to 41 PSU by March 30th and averaged approximately 31 PSU during the continuous circulation period. There was a very different trend in pond salinity concentrations in 2006 with pond salinity steadily increasing throughout the summer from 4.5 PSU in May to 19.5 PSU late in the monitoring season. Salinity trends in 2007 again showed a different pattern. Due to an unusually warm and dry winter, salinity in Pond A18 was at 19.1 PSU in May 2007 and rose to a high of 30.1 PSU in late September. Salinity fluctuations are not controllable on a fine scale in a system such as A18. As a former salt pond, the deliberate original design of a shallow, large surface area pond is for high evapo-transpiration rates leading to increased salinity. In this respect, Pond A18 still functions as a system that concentrates salts through high evapo-transpiration rates. These uncontrollable salinity fluctuations may have a significant impact on pond phytoplankton biomass, dynamics and stability as discussed in a later section.

Since average salinity levels in Pond A18's discharge in 2005 were significantly higher than 2006 and 2007 levels, some stratification of receiving water was observed in the early months of 2005. Particularly during and shortly after the initial release period in 2005, the more saline A18 water would sink to the bottom of Artesian Slough in the area immediately influenced by A18 (up to station 2, Figure 1). However, this stratification was not evident in the late summer of 2005 as pond salinity continued to decrease. In 2006 and 2007, there was no observed vertical stratification of receiving waters as a result of Pond A18 discharge as reported in monthly discrete receiving water monitoring (Table 8). The differences between surface and bottom salinity at downstream stations are explained by tidal action in Artesian Slough (Figure 7). This is particularly evident when examining discrete Artesian Slough water column measurements taken on October 16, 2007 (Table 9). This event occurred during a flooding tidal stage when the discharge from Pond A18 had been shut off for more than 12 hours. Artesian Slough is tidally influenced and twice per day, salt water from the Bay enters the slough with the flooding tide. The slough is dominated by San Jose/Santa Clara Water Pollution Control Plant (Plant) effluent, which is fresh water. The fresh water effluent tends to float on top of heavier, more saline Bay water being pushed into the slough by the flooding tide. The effect of Pond A18 discharge on receiving water salinity is very brief and limited spatially due to immediate mixing of pond discharge water with Plant effluent. This is best illustrated by the lack of salinity stratification in Artesian Slough during non-flooding tides while Pond A18 is discharging (Table 7, June and September results for stations 3 and 4).

pH

Pond pH levels increase during periods of intense photosynthetic activity, when irradiance and temperatures are high. However, there appears to be an upper boundary on pond pH due to the buffering capacity of salt water. Buffering capacity increases with increased salinity. Pond pH levels were temporarily quite high (9.4 – 9.9) at the beginning of the season when pond salinity was at its lowest (Figure 6). By July 2007, pond pH had fallen below a pH of 9 and remained relatively lower (8.4 – 8.9) compared to previous years and the early part of 2007. The timing of this measured decrease in pond pH corresponds to observed changes in the pond's algal community based on observed water color, chlorophyll *a* measurements and phytoplankton species composition data.

Although somewhat high pond pH levels (range for the season of 8.4 – 9.9) may result in some osmotic stress to fish and invertebrates, the slow rate of pH change in well-buffered pond water likely allows pond organisms to adjust. Also, while increasing pond salinity may help to stabilize or buffer pond pH levels, steadily increasing salinity may have a negative impact on pond phytoplankton production and stability.

There is no apparent effect on pH in the receiving water from A18 discharge. Rather, the regular fluctuations of receiving water pH are strongly associated with the tidal cycle (Figure 7).

Adaptive Management of Pond Dissolved Oxygen Levels

Similar to 2005 and 2006, the primary Pond A18 management challenge in 2007 was to maintain dissolved oxygen concentrations (DO) at or above levels required in the Order. Following initiation of adaptive management due to low pond DO levels in 2005, Plant personnel, following the example of Cargill staff, opened the pond discharge gate each day only after first measuring the pond water dissolved oxygen concentration. This procedure was cumbersome and time consuming. The 2005 report also concluded that this procedure "was perhaps too rigorous." Therefore, a more streamlined approach was initiated in 2006. The 2006 adaptive management strategy was to calculate the weekly 10th percentile pond discharge DO value, and, if the value was below the trigger of 3.3 mg/L, evaluate the current week's dataset to determine the best time period to close the discharge gate to limit the discharge of low DO water from the pond. The adjusted gate opening and closing times were then applied to the following week's pond maintenance schedule.

The streamlined adaptive management strategy utilized in 2006 was successful in that there were no excursions below the Basin Plan DO objective of 5 mg/L in the receiving water due to A18 discharge. The same streamlined adaptive management strategy initiated in 2006 was used in 2007. As in the previous 2 years, receiving water DO levels do not appear to be affected, either positively or negatively, by the A18 discharge (Appendix 1; Weeks 1-26). For example, from September 4 -11, DO in the pond discharge fell below 2 mg/L for several hours on 4 consecutive days and rose above 11 mg/L once, with no apparent effect on receiving water (Appendix 1; Week 19). Two additional examples of this lack of cause-and-effect are shown in the DO charts for Weeks 13 and 20 (Appendix 1). Neither prolonged, very high DO discharges (week 20) nor low DO discharges (week 13) appeared to affect receiving water DO in a positive or negative direction. Perhaps the clearest example of the lack of effect of pond discharge on receiving water DO levels was during the last week of September (Appendix 1; Week 22). Discharge flow from A18 averaged 14 MGD for the week and this week had the lowest 10th percentile DO value of all 26 weeks of 2007 (1.3 mg/L). The pond experienced low DO levels with measurements below 2 mg/L for a 10 hour discharge period on 9/28/07 to 9/29/07 and below 4 mg/L for 3 days. During this week, persistent low DO levels again had no observed effect on the normal diurnal DO pattern in the receiving water.

The A18 discharge weekly 10th percentile DO value was below the trigger of 3.3 mg/L six times in 2007 compared to seven in 2006 and only two times in 2005. The greater number of triggering events in 2006 and 2007 were a direct result of the adaptive management scheme to minimize pond gate closures and to maximize flow through the pond. The strategy and resultant triggers did not have any negative effect on receiving water DO levels. As mentioned in previous A18 Self-Monitoring Reports, the City believes that corrective action and pond gate closures should not be initiated unless there is a corresponding, observable effect on the receiving water. The trigger remains a useful regulatory and pond management tool as an early warning signal, which should initiate further evaluation of pond and receiving water DO data. That analysis, in turn, could trigger gate closure action if other criteria are met. Maximizing pond flow-through should be a primary goal in 2008. Prolonged gate closures lead to stagnation which is more likely to destabilize pond conditions in an already dynamic, delicately balanced pond system.

The usual diurnal pattern of pond DO levels is a sinusoidal curve of up-and-down swings in DO due to algal photosynthesis during the day and organism respiration at night in the absence of photosynthesis (Appendix 1; Week 3). Events such as the apparent phytoplankton die-off in July 2006 and changes in phytoplankton community structure beginning in July 2007 and continuing into September 2007 can cause DO levels to decline rapidly (Appendix 1; Weeks 13, 14 and 19). In some cases, such as low DO observed in week 19, conditions can result in stress to pond biota, especially when combined with climatic perturbations such as decreased irradiance due to cloud cover leading to decreased rates of photosynthesis. During this week, on September 4, 2007, hundreds of stickleback fish were observed clustered at the surface of the pond near the discharge gulping air. This appeared to be a direct result of extreme DO swings and persistently low DO conditions in the pond during weeks 18 and 19 (see Appendix 1). Observations in 2006 and 2007 indicate that irradiance affects pond DO levels. For the two-week period (weeks 18 and 19) leading up to the September 4 stressed fish observation, average daily irradiance levels as measured in Union City[3] were 232 W/m^2. This is less than averages from the previous two weeks (266 W/m^2). In particular, on September 4, 2007, average irradiance (185 W/m^2) was the lowest daily average recorded for approximately one-month prior. the Qualitative observations on cloud cover indicates that weekly pond 10th percentile DO values in both years tended to be lower for weeks which had one or more cloudy days. Irradiance and cloud cover are natural, uncontrollable variables. To understand this important natural variable better, the City ordered a light meter and continuous logger to measure irradiance. Unfortunately, the equipment was not adequate or functional for continuously measuring light levels at Pond A18. In the future, the City plans to utilize irradiance data collected regionally to correlate variations in pond DO levels with irradiance measurement. This additional data should aid in our understanding of pond DO dynamics and ability to better manage the pond adaptively.

Average discharge flow volume from Pond A18

Artesian Slough is dominated by continuous freshwater flows from the Plant of approximately 100 MGD. In contrast, the average discharge volume from A18 during the 2007 monitoring season was 14.4 MGD. This average daily flow from A18 in 2007 is less than that of 2006 (17.6 MGD) despite increased discharge times for 2007. The slight drop in flow from 2006 to 2007 is due to modifications to discharge valve settings in order to maintain a consistent pond water depth.

The flow from A18 is highly variable depending on discharge gate settings, pond water level and tidal height in Artesian Slough. However, the average flow is only 14.4% of the Plant's continuous daily flow. In addition to the relatively small discharge volume into Artesian Slough, there appears to be rapid mixing of pond discharge with receiving water. These two factors likely account for the negligible or immeasurable effect of pond discharge on receiving water even at Artesian Slough station 2 (Table 8), which is immediately downstream of the pond discharge point. Even immediately downstream of Pond A18 discharge, where the influence of the pond should be the greatest, variations in DO, pH and salinity are more influenced by interactions between Plant effluent and tidal influence than discharge from Pond A18. As noted above, adaptive management of discharge flows in 2005 resulted in longer periods of gate closure throughout the monitoring season compared to 2006 and 2007. Because of this, the average flows in 2006 and 2007 likely represents a greater average discharge from A18 compared to 2005.

Mercury and Methyl Mercury Analysis of Pond Sediment.

In 2005, there was a noticeable difference in mercury and methyl mercury concentrations spatially within pond sediment. Concentrations of both mercury and methyl mercury in pond sediment were greater in northern areas of the pond in 2005. Methyl mercury concentrations in particular were as much as 23-times greater at the extremes (stations 1 and 4) when concentrations were normalized to percent clay. In contrast, 2006 pond sediment mercury and methyl mercury concentrations appeared fairly uniform, especially when normalized to percent clay. Mercury and methyl mercury concentrations in pond sediment in 2007 showed yet another

[3] Irradiance data obtained from California Irrigation Management Information Systems (CIMIS) at wwwcimis.water.ca.gov/cimis/data.jsp

trend. Total mercury concentrations in pond sediment were higher in the southern portions, especially when normalized to percent clay. This is in direct contrast to the apparent spatial trend for total mercury observed in 2005 (high in north and low in south). Methyl mercury concentrations in pond sediment showed more variability but were highest in the most northern stations (A18-4) as was observed in 2005. It is impossible to determine what may account for the inter-annual or occasional spatial variability between 2005, 2006 and 2007 due to a limited dataset. The complexity of factors contributing to mercury methylation and lack of information on sediment dynamics in Pond A18 further confound this issue.

Mean (±SE) sediment mercury and methyl mercury concentrations in A18 from three years of monitoring data are 229 ±32 ng/g and 1.22 ±0.42 ng/g respectively. Compared to the most recent (2004 – 2006) three years of available RMP data[4] for mercury concentrations in Lower South Bay and Southern Sloughs, mean total mercury and mean methyl mercury concentrations in nearby Bay sediments are very similar to those in A18 (Table 14). While the mean concentrations are similar, mercury in Pond A18 sediments has been much more variable than in South Bay sediments as shown by the higher standard error for pond data. The smaller sample size for pond sediment mercury data may be a factor affecting statistical variability. However, mercury concentrations in Pond A18 sediments span a greater range of values than those measured in the Bay.

Table 14. Comparison of Mean (± SE) Mercury and Methyl Mercury Concentrations in A18 Sediments to South Bay Concentrations from RMP Data[3].

Data Source	Total Mercury (ng/g)	n	Methyl Mercury (ng/g)	n
A18 sediment	229 ± 32	13	1.22 ± 0.42	13
South Bay sediment (RMP)	251 ± 8	30	0.85 ± 0.06	30

Pond Primary Production

In partnership with the U.S. Geological Survey (USGS), the City is analyzing required and supplemental data from A18 collected in 2006 to characterize the pond ecology with respect to pond primary productivity and estimating the pond's carrying capacity to support biota in two idealized food-webs. This analysis has already resulted in a presentation[5] at a national conference (Estuarine Research Federation, November 2007 in Providence, RI; Appendix 7). Additionally, a companion paper has been drafted and submitted to the peer-reviewed journal, Wetlands for publication in the scientific literature. A summary of that paper follows.

Due to low water levels (approximately 2 feet) in Pond A18, high summer irradiance, low flow-

[4] 2004 – 2006 Regional Monitoring Program Status and Trends data for Bay sediment mercury and methyl mercury concentrations for stations located south of the Dumbarton Bridge.
[5] J. Thèbault, Schraga, T.S., Cloern, J.E,, and Dunlavey, E.G. Funky Green Biomass Machines: The Former Salt Ponds of South San Francisco Bay, CA. Poster Presentation at 2007 Estuarine Research Federation Conference, Providence, RI.

through rates, and availability of nutrients, phytoplankton blooms were common in 2005 and 2006. A dramatic phytoplankton bloom was not observed in 2007 (Table 12), but chlorophyll *a* levels did increase steadily throughout the monitoring season (from 13 μg/L to 52 μg/L). A similar increasing trend but with a greater magnitude occurred in 2005 (19 μg/L to 300 μg/L). In 2006, chlorophyll *a* concentrations were already relatively high in May (210 μg/L) but declined rapidly after mid July and remained relatively low for the remainder of the season with respect to initial 2006 concentrations.

While extreme variations in chlorophyll *a* were not observed in 2007, the physical properties of the pond, high irradiance and low flow through rates result in a highly productive system. Based on the high resolution continuous dissolved oxygen data collected in Pond A18 for 2006, mean Gross Primary Production (GPP) is estimated to be 8.2 g O_2 /m^2/day. This indicates very high rates of photosynthesis in the pond and is double the rate of some of the world's most productive estuaries, such as the Chesapeake Bay[6]. Dissolved oxygen data from 2007 is similar to that of 2006. Therefore, 2006 estimates of GPP are a likely approximation for those of 2007.

High rates of photosynthesis, which cause the extremely high dissolved oxygen levels measured in the pond (maximum of 17.9 mg/L, Table 6), are balanced by high rates of ecosystem respiration (ER) by pond algae, zooplankton, benthic invertebrates and fish. High respiration rates, particularly at night when photosynthesis ceases, cause extremely low dissolved oxygen levels measured in the pond (minimum of 0.0 mg/L, Table 6). The extremes of GPP and ER in Pond A18 provide a beneficial food supply function. However, the extreme nature and apparent tight coupling of GPP and ER also result in a system that is highly susceptible to hypoxic events due to periods of decreased irradiance (decreases photosynthetic rates), prolonged increased temperature (increases metabolism and respiration) and possibly seasonal and monthly swings in salinity that may induce changes in phytoplankton species dominance.

Chlorophyll *a* results from 2006 indicated a rapid decline in pond phytoplankton biomass in July 2006. This corresponded to an observed color change in Pond A18 and to the prolonged heat wave that occurred in the Bay area. It was suspected that this was due to a die-off of pond phytoplankton. Corresponding declines in pH and DO provided further evidence that a die-off did occur in 2006. Dead algal cells would be expected to decompose and the decomposition would use up oxygen and release carbonic acid. To better understand pond phytoplankton dynamics, the City determined that it would be helpful to sample the pond periodically for phytoplankton species composition and abundance. Such analyses could better describe what may be occurring during an algal bloom and/or crash and the reason for any crash event that may take place in A18 in the future.

This additional sampling was implemented in 2007 and while there did not appear to be a rapid die-off of phytoplankton in 2007, data indicates that a more gradual transition likely occurred in Pond A18. Steady increases in chlorophyll *a* throughout the season along with simultaneous observed color changes from brown to green, declines in pH and DO and observed stressed fish (stickleback gulping air at the surface) on September 4, 2007 were indicative of a change in the algal community. An analysis of the phytoplankton species composition of the pond before,

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[6] Kemp, W.M, E.M Smith, M. Marvin-DiPasquale and W.R. Boynton. 1997. Organic carbon balance and net ecosystem metabolism in Chesapeake Bay. Marine Ecology Progress Series 150:229-248.

during and after the period in question confirms that the Pond did indeed transition from an autotrophic community dominated by a filamentous cyanobacteria (*Anabaenopsis milleri*) to one dominated by a diatom (*Cyclotella atomus*). Unlike 2006, there was not an obvious perturbation event (prolonged heat wave) to explain this transition. The change in phytoplankton community structure in 2007 could be due to the gradually increasing salinity, the die-off of observed filamentous macro-algae in the pond, decreased light levels, increased water column shading due to algal proliferation, or a combination of these or other factors.

In 2005, there was little evidence of floating filamentous green algae in Pond A18. This was in sharp contrast to other South Bay Salt Ponds that reportedly had a rather large presence of these nuisance algae. Filamentous algae consist of macroscopic filaments which are of little value to pond productivity since filter-feeding zooplankton (copepods, cladocerans, rotifers, shrimp, aquatic insects) are not able to utilize them effectively. Filamentous algal mats also block light penetration into the water column, thereby decreasing phytoplankton production and overall pond productivity.

In 2006, filamentous algae in Pond A18 became more noticeable, especially during the latter half of the season. The increase in filamentous algae in 2006 may have been due to the phytoplankton die-off that occurred. With decreased phytoplankton abundance, there was a corresponding decrease in shade competition. In 2007, there were noticeably more filamentous algae in Pond A18 (maximum coverage estimated at 40%), especially in the early months of the monitoring season (May and June). Conditions in early 2007 with respect to salinity, pH and chlorophyll *a* concentrations were similar to those at the end of 2006. These conditions appear to be favorable for the growth of nuisance algal mats. Decreases in the amount of filamentous algae in Pond A18 also corresponded to the July transition period discussed above. Die-off of algal mats could have also contributed to measured decreases in pH, DO and observed changes in the phytoplankton community structure. If the changes in the abundance of filamentous algae, phytoplankton composition and chlorophyll *a* observed in 2006 and 2007 were due to uncontrollable factors such as variations in irradiance, temperature or increasing pond salinity in a pond designed for high evapo-transpiration rates, such changes are likely unavoidable.

Supplemental Monitoring

In September 2006, the City collaborated with USGS to initiate a supplemental monitoring program for Pond A18. Initially, the primary purpose of this monitoring was to characterize how well mixed the pond was and the effect of pond discharge on receiving water. This was accomplished using a variety of analytical measurements (chlorophyll *a*, nutrients, salinity, TSS, mercury and methyl mercury) and statistical analysis of these measurements that were presented in the 2006 Report. Supplemental monitoring in 2006 indicated that Pond A18 is fairly uniform with respect to most parameters measured.

As a result of limited staff time in 2007 compared to 2006, supplemental monitoring was scaled back to include only collection of monthly phytoplankton species composition samples. Four of these samples were analyzed to provide additional evidence and insight into possible changes in the pond's autotrophic community throughout the dry season. These results provided valuable information to inform the discussion on Pond Primary Production.

VI. Lessons Learned and Recommendations

- In 2007, Pond A18 discharge averaged approximately 14% of the Plant flow. There was no observable effect on receiving water from A18 discharge on any water quality parameter despite more frequent pond discharges compared to 2005 and 2006.

  Recommendation: As was recommended in previous reports, rather than immediately closing the discharge gate when weekly pond discharge DO levels fall below the 10th percentile trigger (3.3 mg/L), the City recommends using the 10th percentile pond DO trigger of 3.3 mg/L as an early warning signal and to limit flows from A18 only when further analysis of continuous DO data and weather conditions suggests a potential threat to the receiving water DO objective.

- Salinity stratification in Artesian Slough occurs during flood tides as a result of freshwater Plant discharge flowing over denser incoming saltwater. During ebb tides near low tide, when A18 has significant discharge, there is less salinity stratification in Artesian Slough, probably due to dilution of pond water with Plant flows.

  Recommendation: Follow recommendation in first bullet point above. This is further evidence of the minimal impact A18 discharge has in Artesian Slough.

- The effect of tides and ambient dissolved oxygen concentrations is greater than the effect of A18 discharge on Artesian Slough DO levels. Bottom DO concentrations at Artesian Slough stations nearest the A18 discharge are higher than surface DO concentrations further downstream in Artesian Slough (Figure 8).

  Recommendation: Follow recommendation in first bullet point above. This is further evidence of the minimal impact A18 discharge has in Artesian Slough.

- Supplemental monitoring performed in 2006 and 2007 provided useful information for characterizing variability of the Pond A18 phytoplankton community and how climatic and water quality factors may affect pond stability.

  Recommendation: As time, staff resources, and budget allow, continue voluntary supplemental monitoring of Pond A18 and possibly Artesian Slough. Expand supplemental monitoring as feasible and appropriate.

- The most important factor affecting dramatic changes in pond DO levels (lows and highs) may be irradiance. Pond conditions were affected by weather patterns and most differences between monitoring seasons can be accounted for by the difference in weather, with 2007 having a cooler summer, with warming towards the end of the monitoring season.

  Recommendation: Use irradiance measurements taken locally at weather stations or through reliable quality controlled irradiance monitoring programs during the A18 monitoring season to correlate irradiance and DO levels.

- Pond A18 is has very high primary productivity due to the large biomass of phytoplankton. Because of this high productivity, decreases in irradiance on shorter temporal scales (hours or days) due to cloud cover or rain events can cause temporary periods of low dissolved oxygen due to decreased rates of photosynthesis.

  Recommendation: Follow recommendation in the first bullet point. Changes in irradiance are natural and uncontrollable. Shutting the discharge valve as a result of temporary low DO due to decreased irradiance may exacerbate a low DO incident due to stagnation of pond water. No adverse effects on receiving water DO have been measured in three years of monitoring.

- After three years of monitoring mercury and methyl mercury in Pond A18 sediments, no consistent pattern between years or among stations is evident.

  Recommendation: Continue annual monitoring of mercury and methyl mercury concentrations in sediment as required in the Order. Evaluate utility and feasibility of additional limited in-pond core sampling and analysis to characterize pond sediments and sediment-bound persistent pollutants such as mercury.

- Pond phytoplankton community structure and dynamics may be directly affected by salinity. Pond salinity increases throughout the dry season, may tend to destabilize the phytoplankton community and cause shifts in species dominance. Phytoplankton biomass and overall stability can greatly affect pond DO levels through high photosynthesis and respiration rates. An unstable phytoplankton community can cause very extreme DO concentrations with extremely high DO during peak photosynthetic activity and hypoxia at night in the absence of photosynthesis. Increased oxidation and decomposition of lysed cells due to changes in community structure can also contribute to decreased DO concentrations.

  Recommendation: Continue to track and characterize pond phytoplankton blooms and general community structure through sampling of chlorophyll *a*, phytoplankton species abundance and composition, and nutrients.

In addition, the City recommends continued collaboration with USFWS and the Regional Water Board for the upcoming monitoring season.

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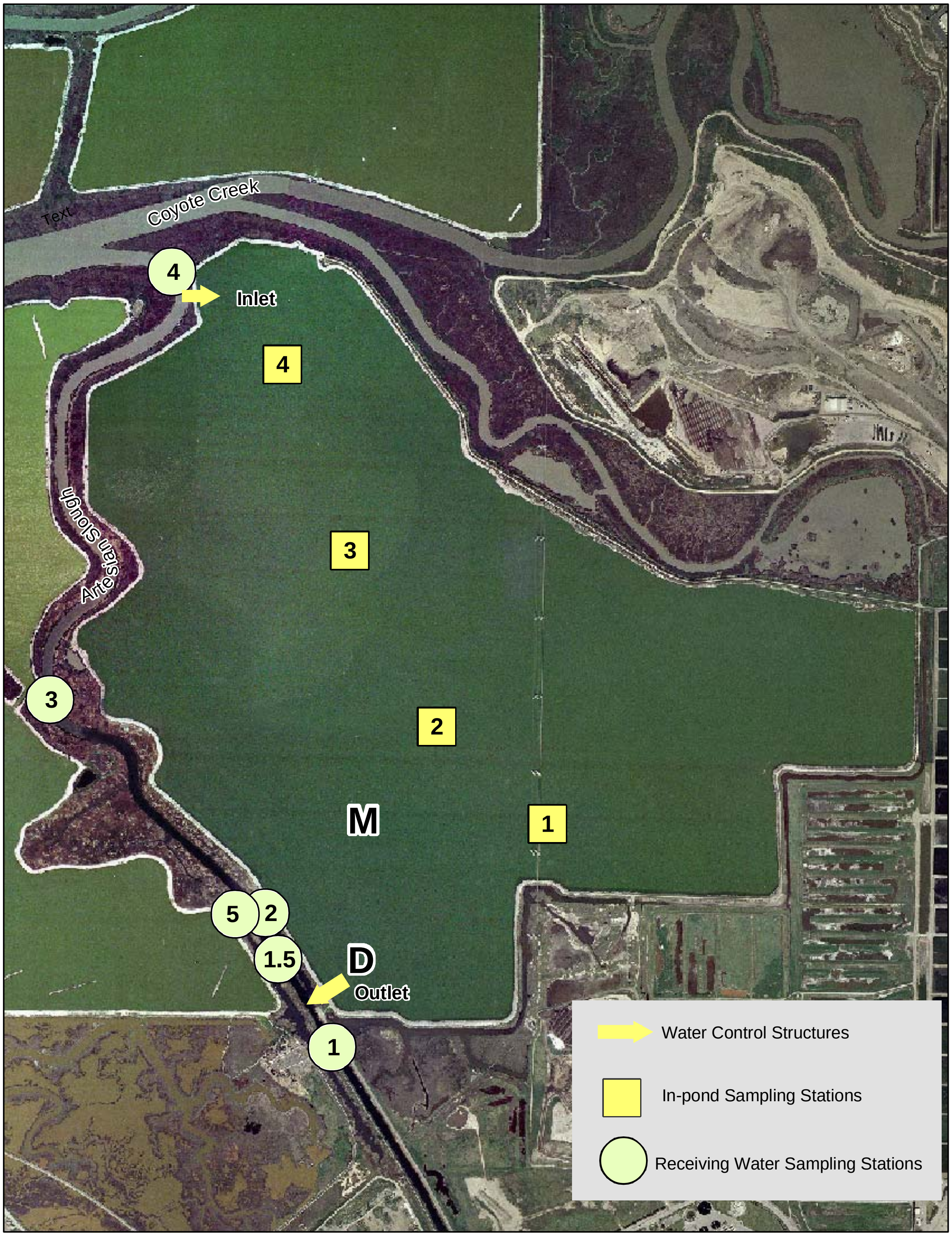


Figure 1. Artesian Slough and Pond A18 Monitoring Stations

Pond stations are referred to in the text as 1,2,3, & 4 (yellow squares). Artesian Slough stations (green circles) and Pond stations D and M are abbreviated in this figure. For example, station A-A18-1 is abbreviated as 1, A-A18-D is abbreviated as D, etc. Stations 2 (for discrete monitoring) and 5 (for continuous monitoring) are located at the same site in Artesian Slough.

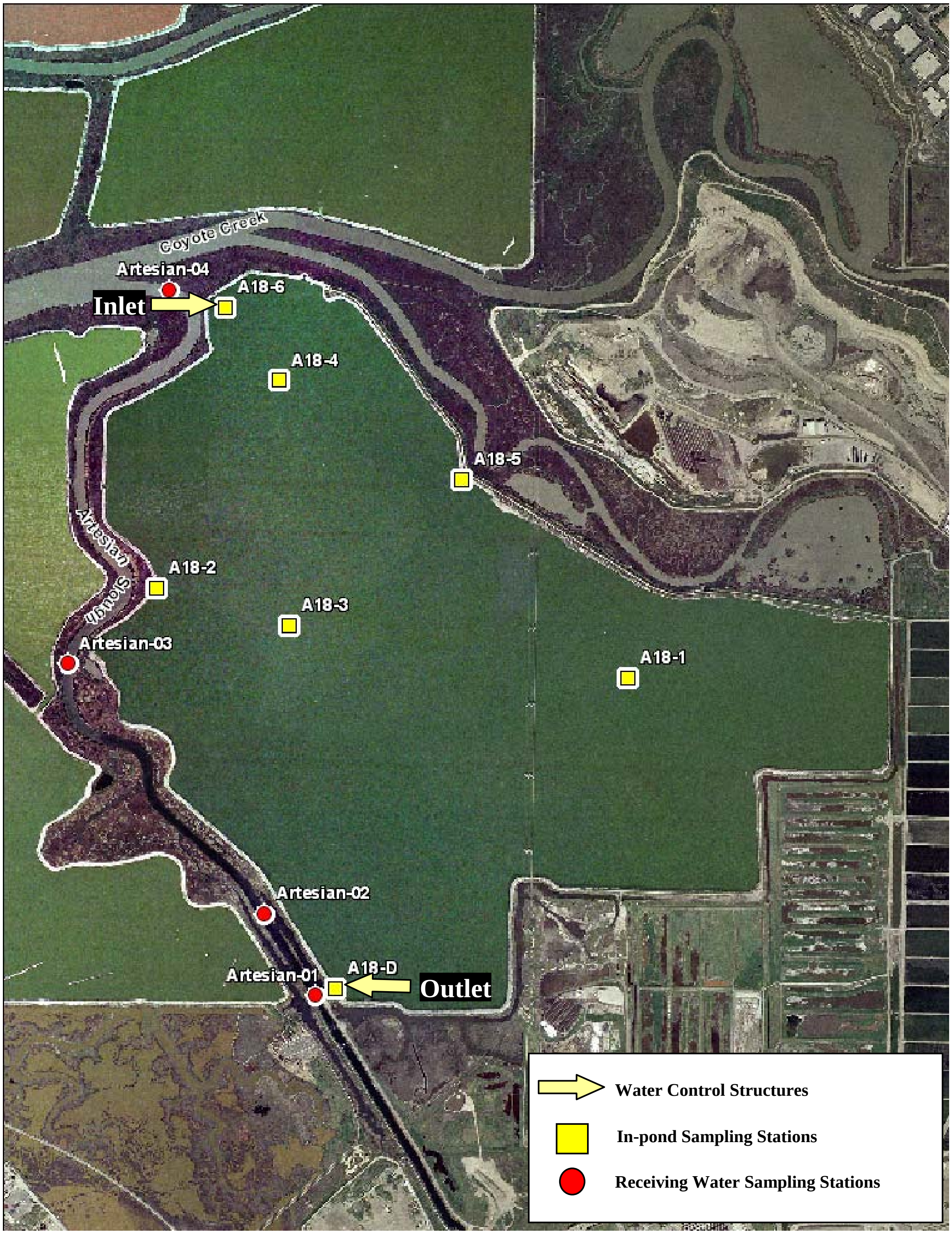


Figure 2. Artesian Slough and Pond A18 Supplemental Monitoring Stations from 2006 Supplemental Monitoring.

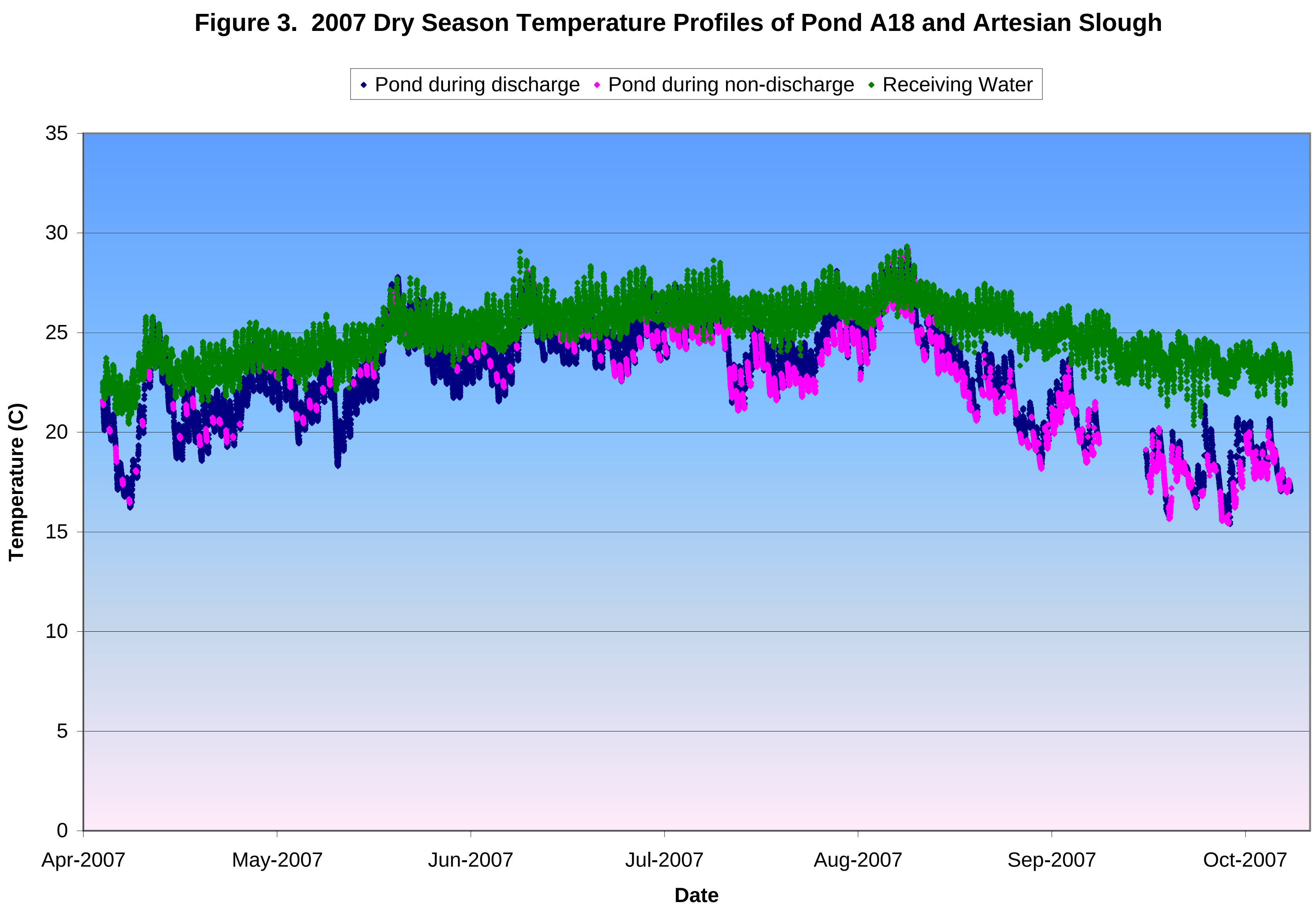


Figure 3. 2007 Dry Season Temperature Profiles of Pond A18 and Artesian Slough
Pond during discharge
Pond during non-discharge
Receiving Water
Temperature (C)
35
30
25
20
15
10
5
0
Apr-2007
May-2007
Jun-2007
Jul-2007
Aug-2007
Sep-2007
Oct-2007
Date

Figure 4. 2007 Temperature Difference Between A18 Discharge and Artesian Slough

Negative values indicate that Pond A18 discharge temperature is less than Artesian Slough

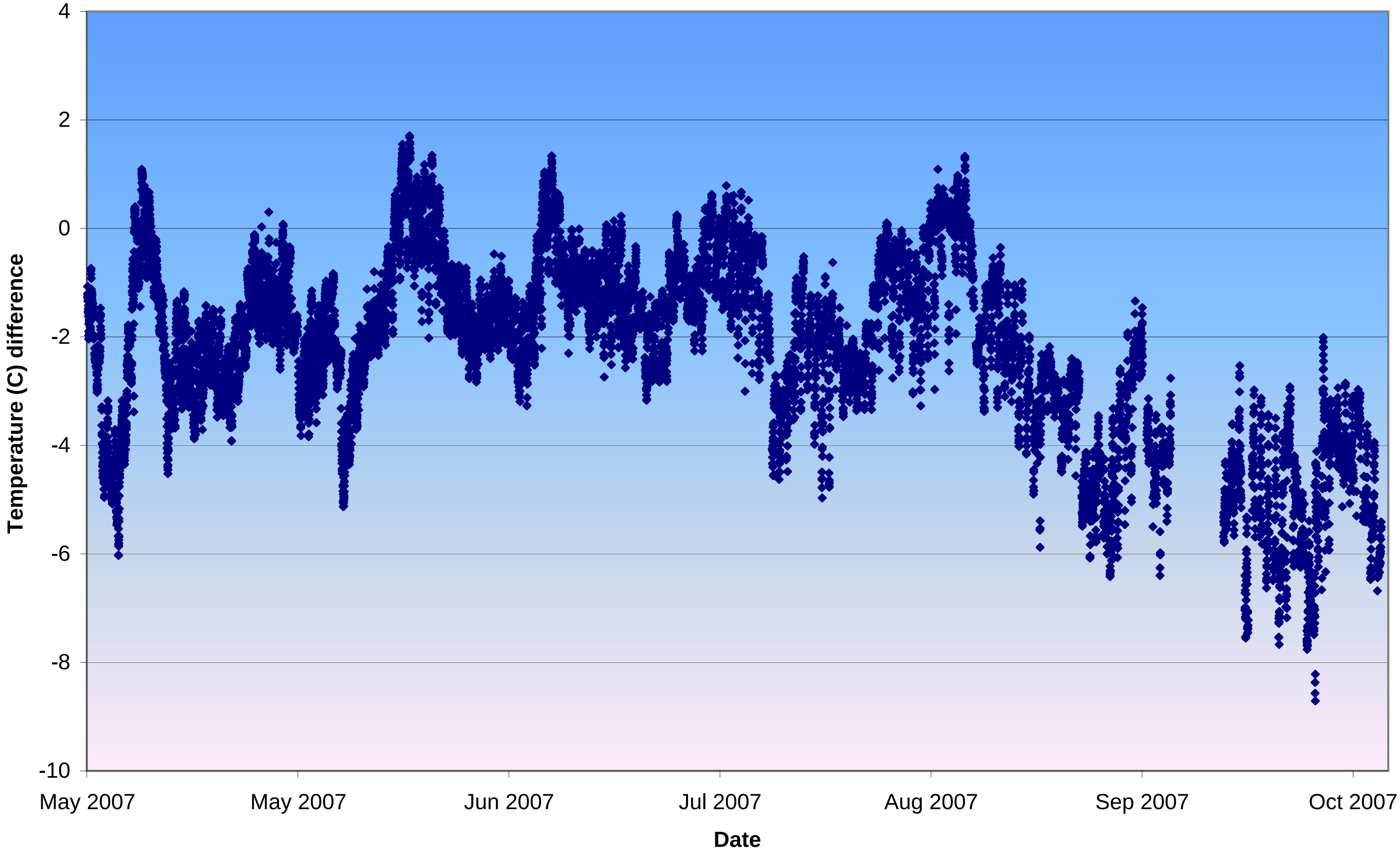


Figure 5. 2007 Dry Season Salinity Profiles of Pond A18 and Artesian Slough

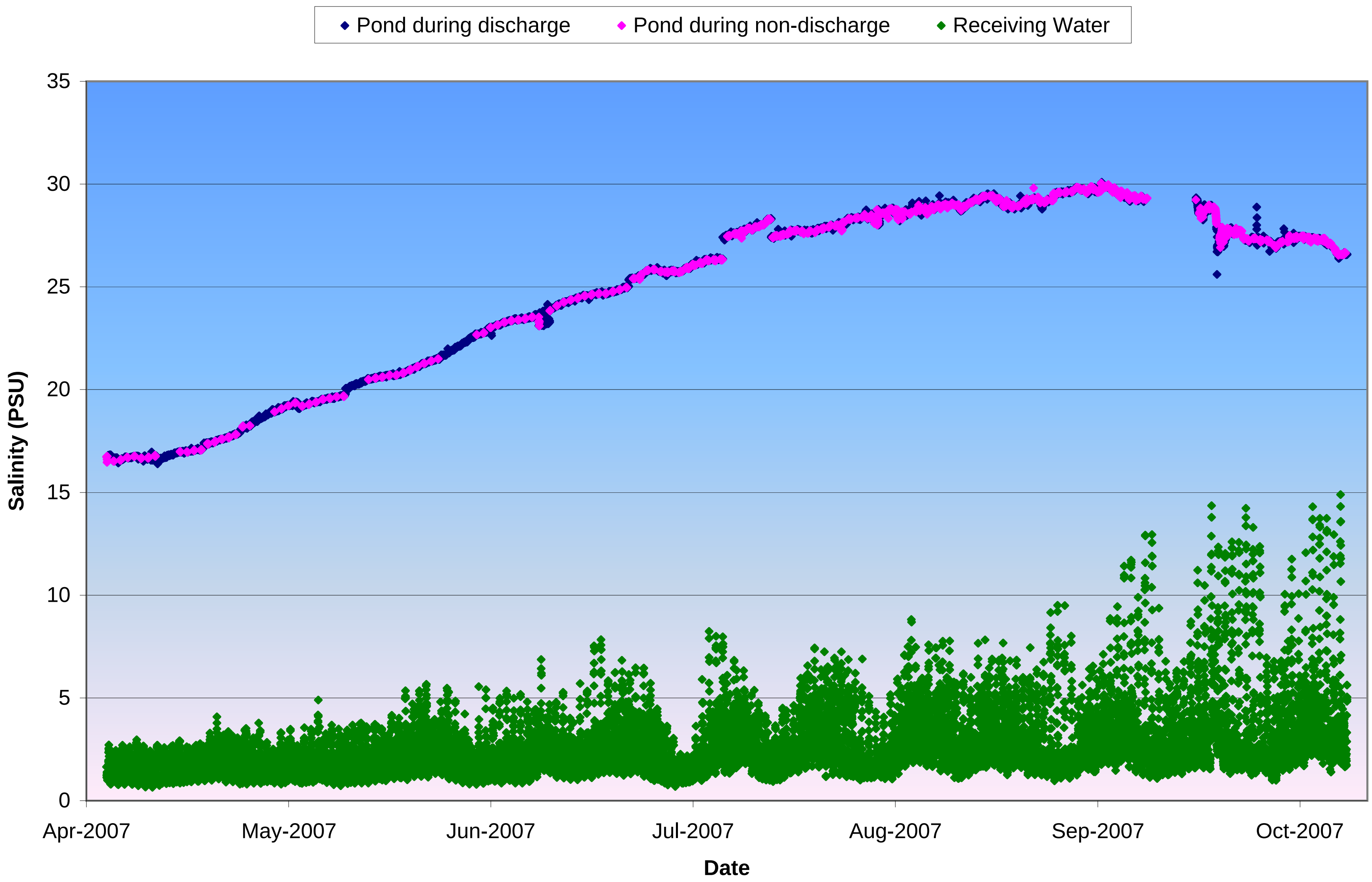
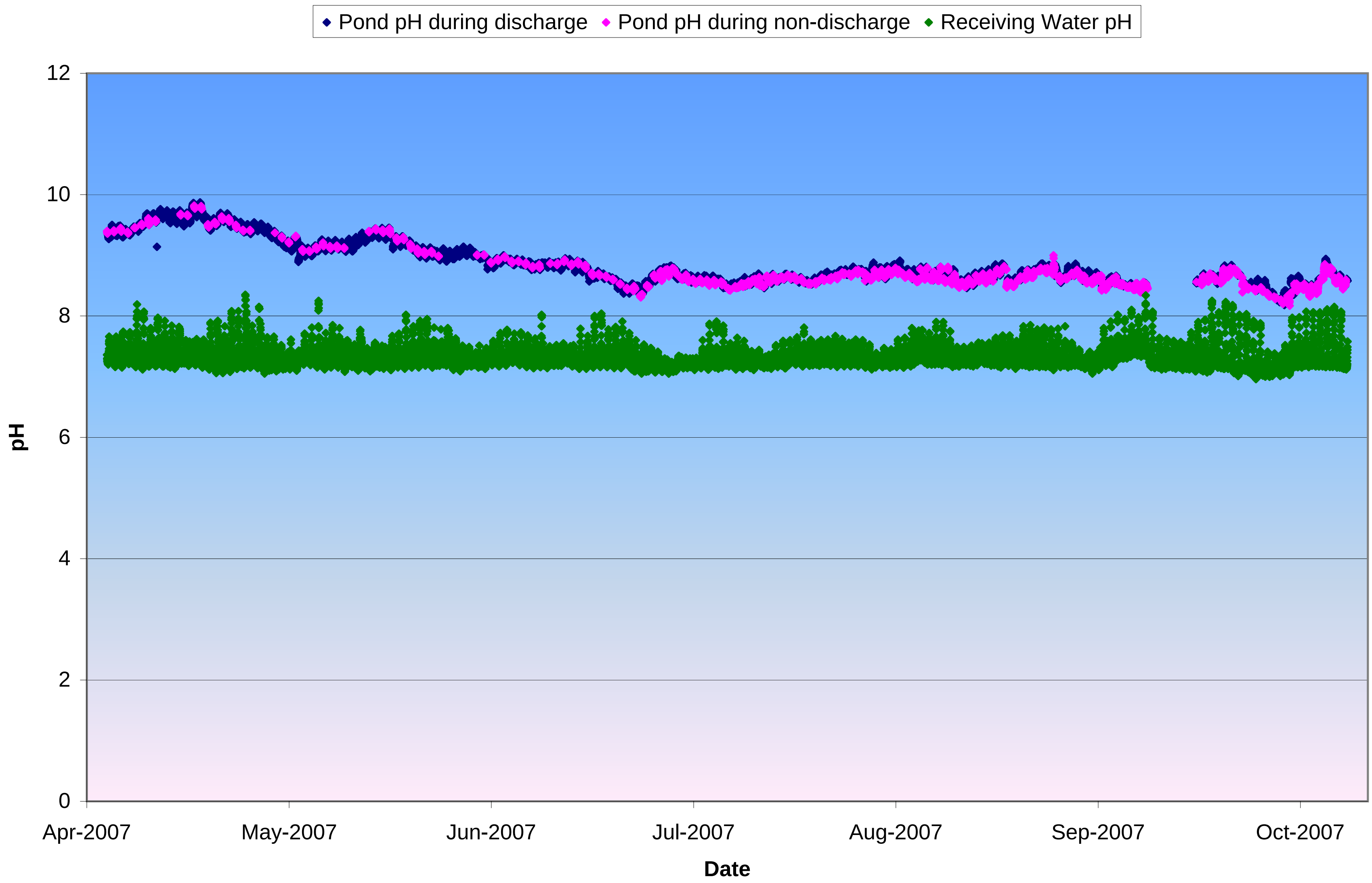


Figure 6. 2007 Dry Season pH Profiles of Pond A18 and Artesian Slough



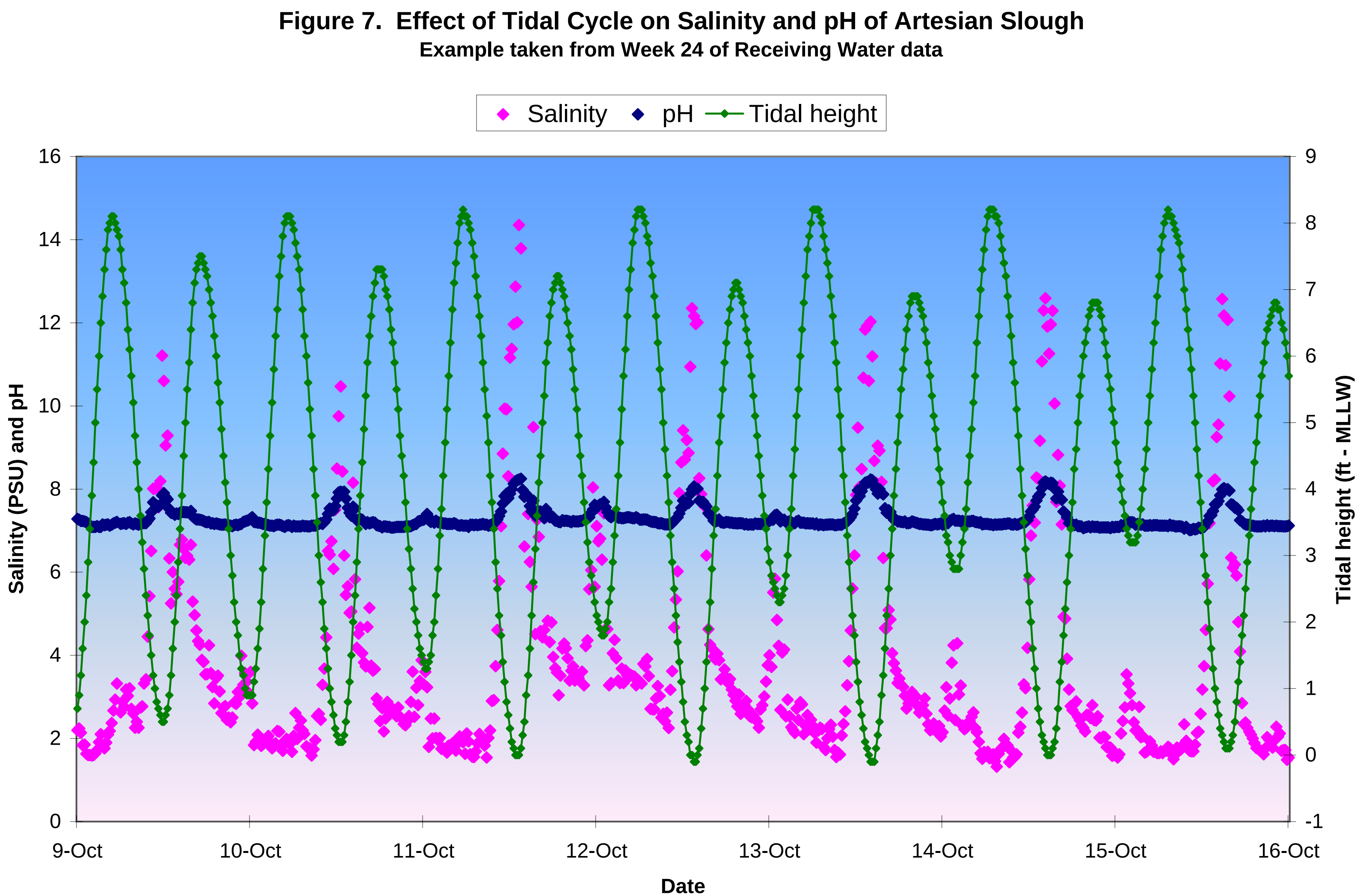


Figure 7. Effect of Tidal Cycle on Salinity and pH of Artesian Slough
Example taken from Week 24 of Receiving Water data
Salinity
pH
Tidal height
Salinity (PSU) and pH
Tidal height (ft - MLLW)
0
2
4
6
8
10
12
14
16
-1
0
1
2
3
4
5
6
7
8
9
9-Oct
10-Oct
11-Oct
12-Oct
13-Oct
14-Oct
15-Oct
16-Oct
Date

Figure 8. Mean (±SE) Monthly Dissolved Oxygen in Artesian Slough for 2007

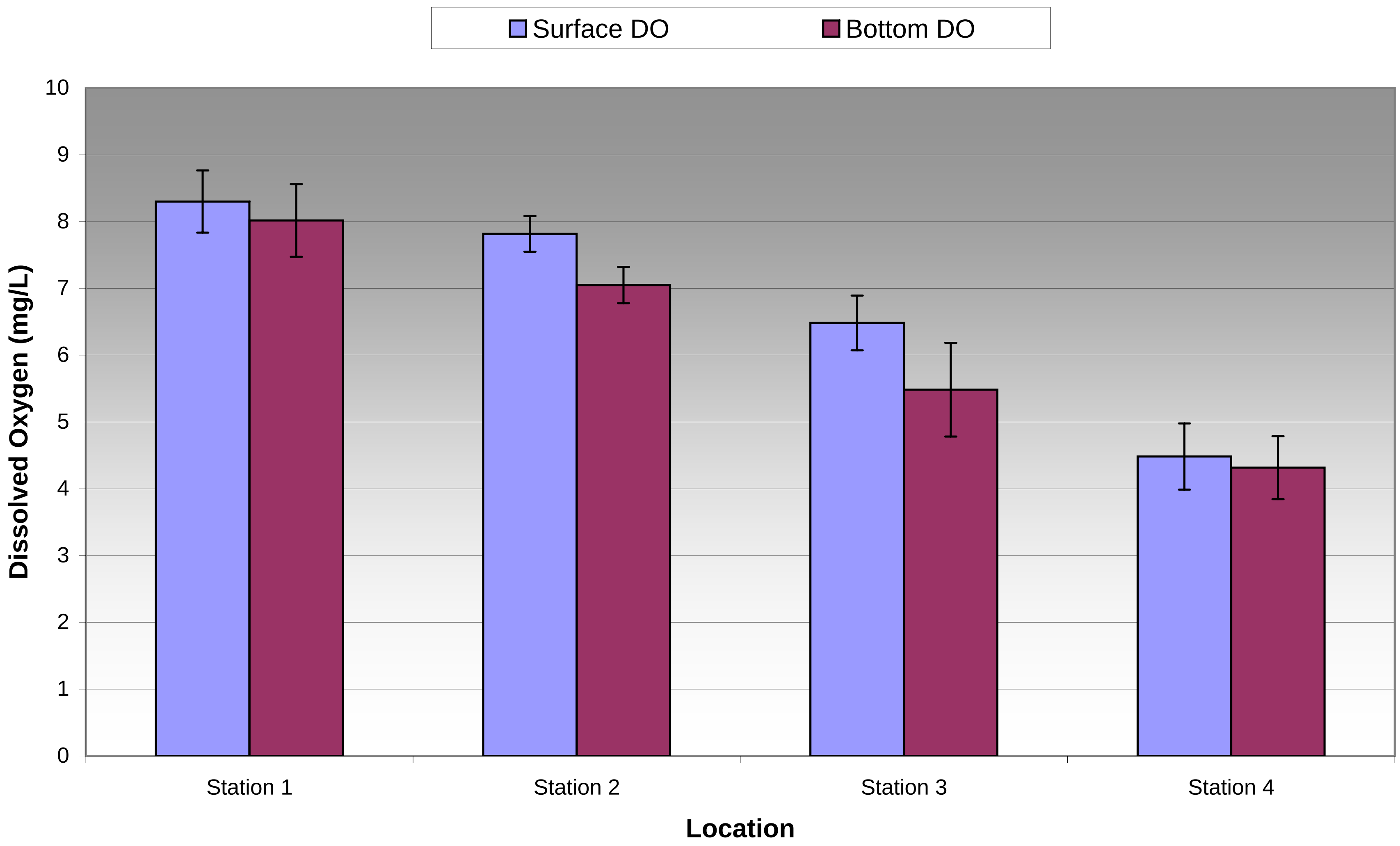
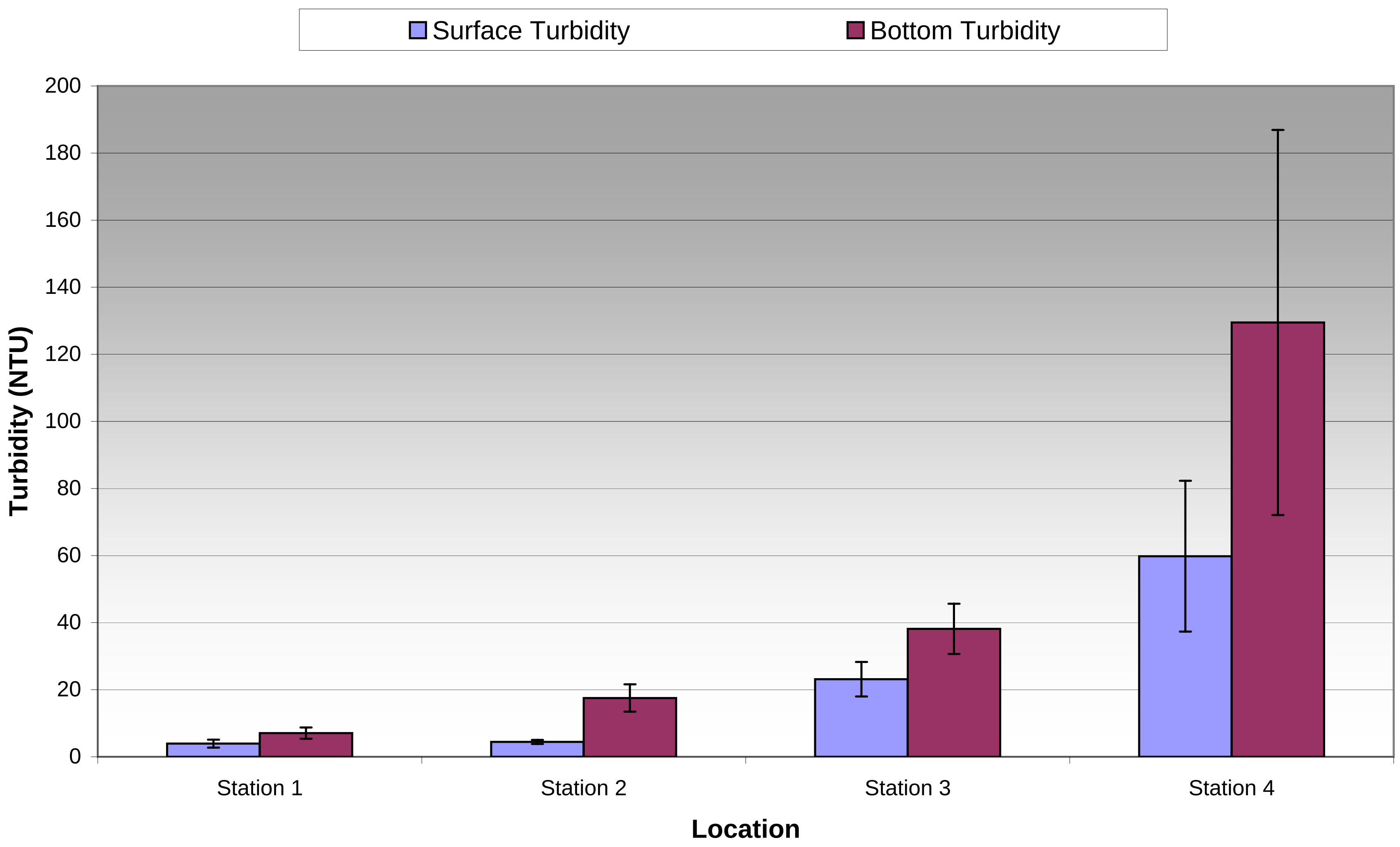


Figure 9. Mean (+SE) Monthly Turbidity in Artesian Slough for 2007



Appendix 1. Continuous Monitoring of Dissolved Oxygen in Pond A18 and in Artesian Slough

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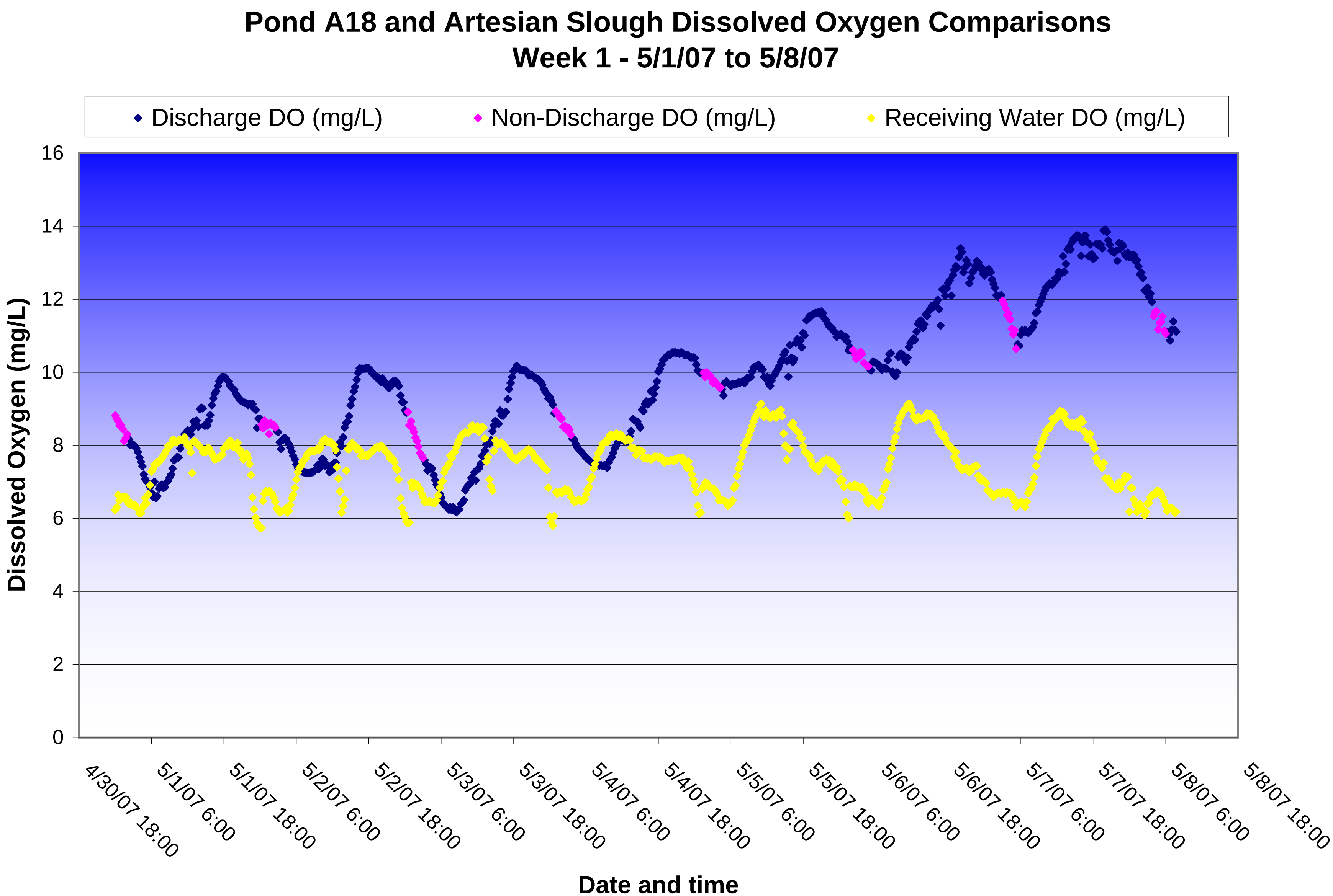
Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 1 - 5/1/07 to 5/8/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
16
14
12
10
8
6
4
2
0
4/30/07 18:00
5/1/07 6:00
5/1/07 18:00
5/2/07 6:00
5/2/07 18:00
5/3/07 6:00
5/3/07 18:00
5/4/07 6:00
5/4/07 18:00
5/5/07 6:00
5/5/07 18:00
5/6/07 6:00
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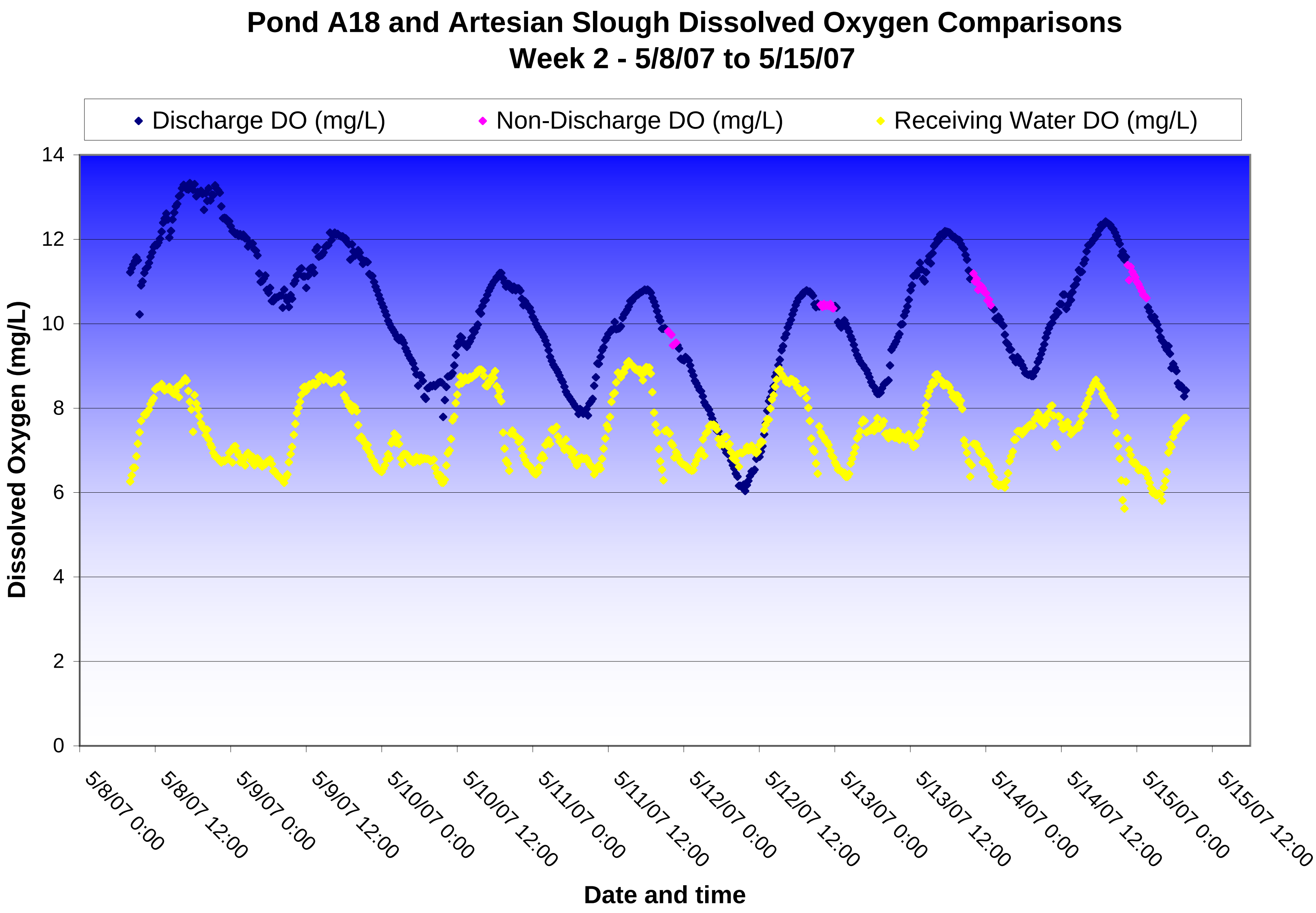
5/7/07 18:00
5/8/07 6:00
5/8/07 18:00
Date and time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 2 - 5/8/07 to 5/15/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
5/8/07 0:00
5/8/07 12:00
5/9/07 0:00
5/9/07 12:00
5/10/07 0:00
5/10/07 12:00
5/11/07 0:00
5/11/07 12:00
5/12/07 0:00
5/12/07 12:00
5/13/07 0:00
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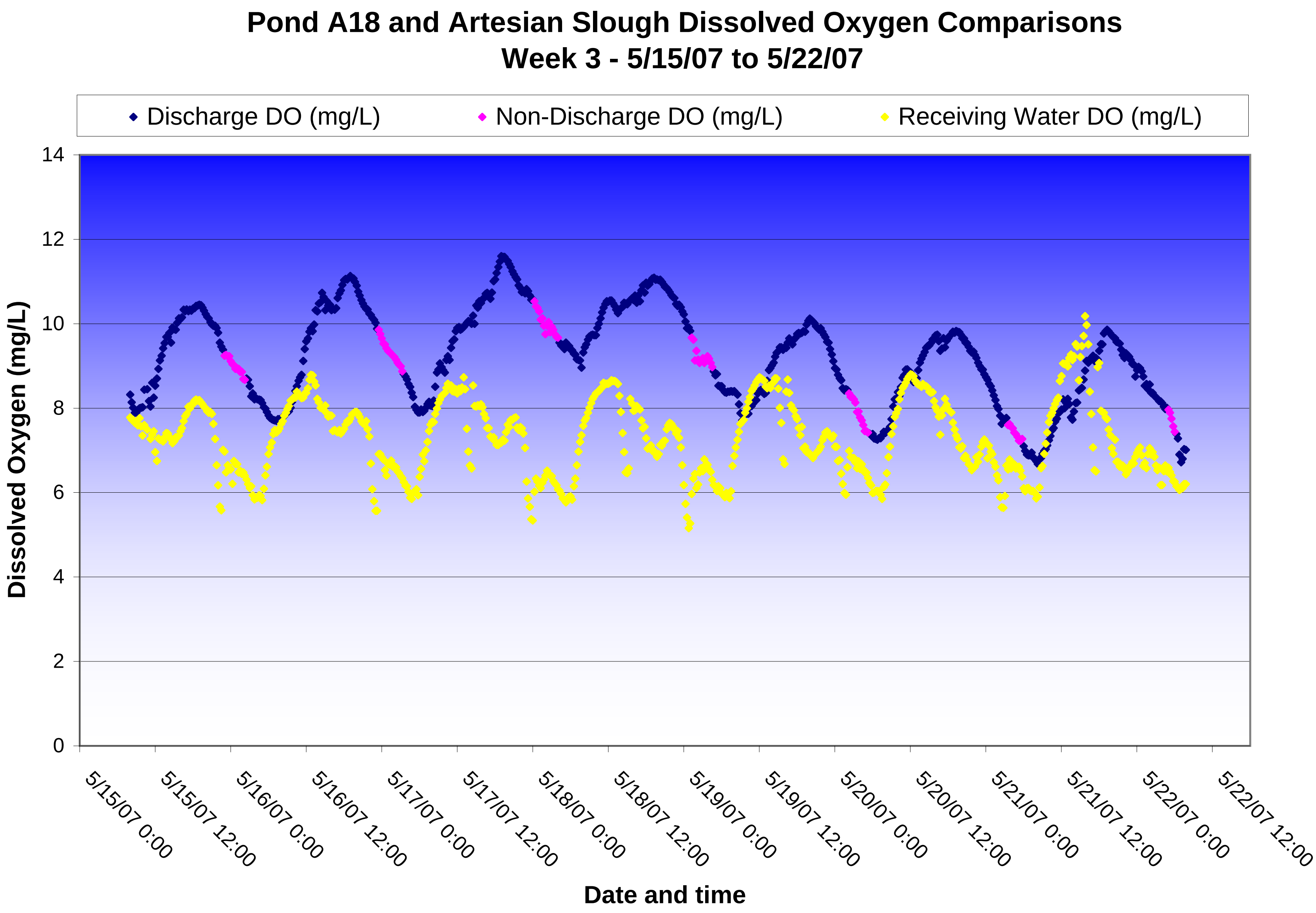
5/15/07 0:00
5/15/07 12:00
Date and time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 3 - 5/15/07 to 5/22/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
14
12
10
8
6
4
2
0
5/15/07 0:00
5/15/07 12:00
5/16/07 0:00
5/16/07 12:00
5/17/07 0:00
5/17/07 12:00
5/18/07 0:00
5/18/07 12:00
5/19/07 0:00
5/19/07 12:00
5/20/07 0:00
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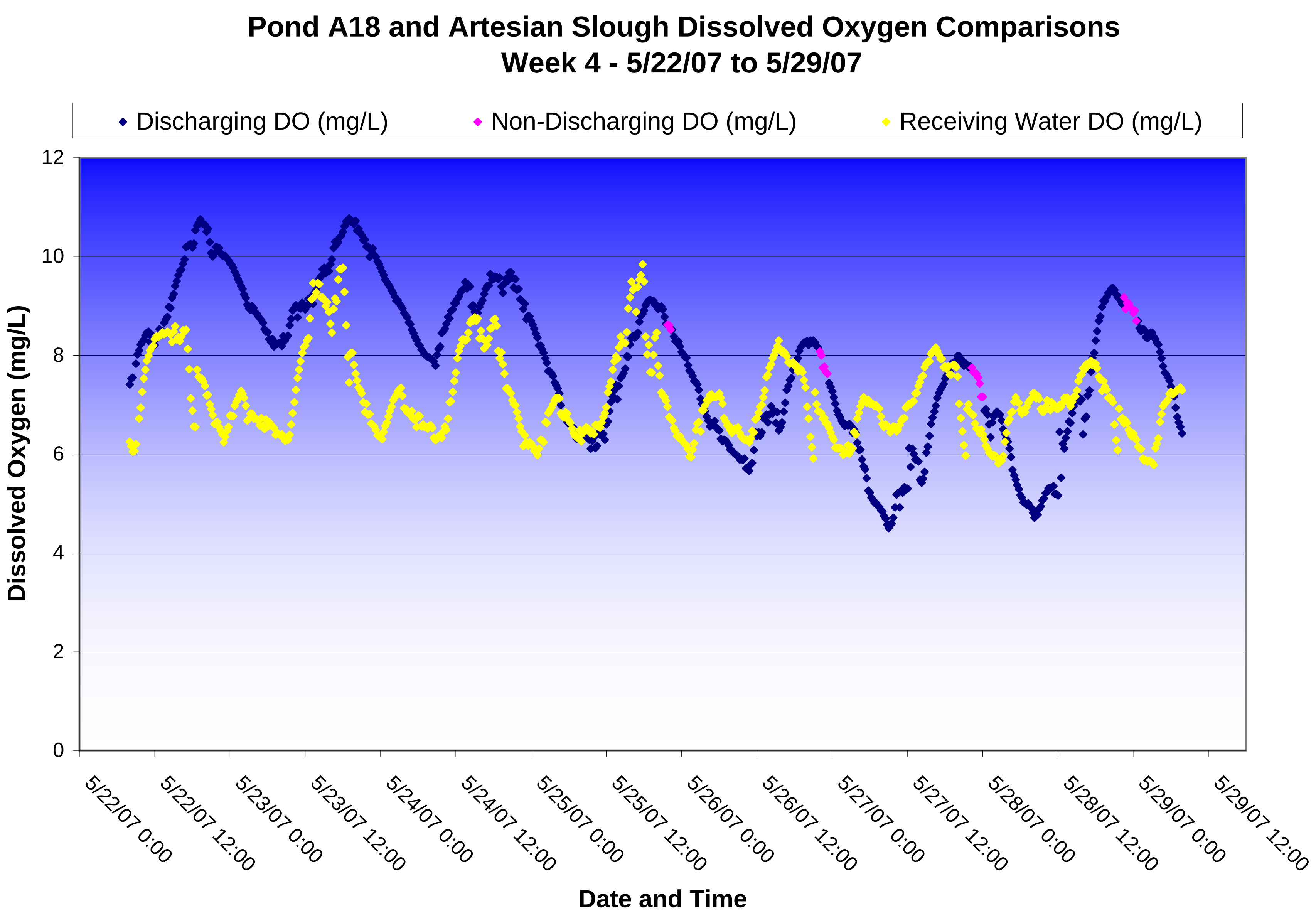
5/22/07 0:00
5/22/07 12:00
Date and time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 4 - 5/22/07 to 5/29/07
Discharging DO (mg/L)
Non-Discharging DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
5/22/07 0:00
5/22/07 12:00
5/23/07 0:00
5/23/07 12:00
5/24/07 0:00
5/24/07 12:00
5/25/07 0:00
5/25/07 12:00
5/26/07 0:00
5/26/07 12:00
5/27/07 0:00
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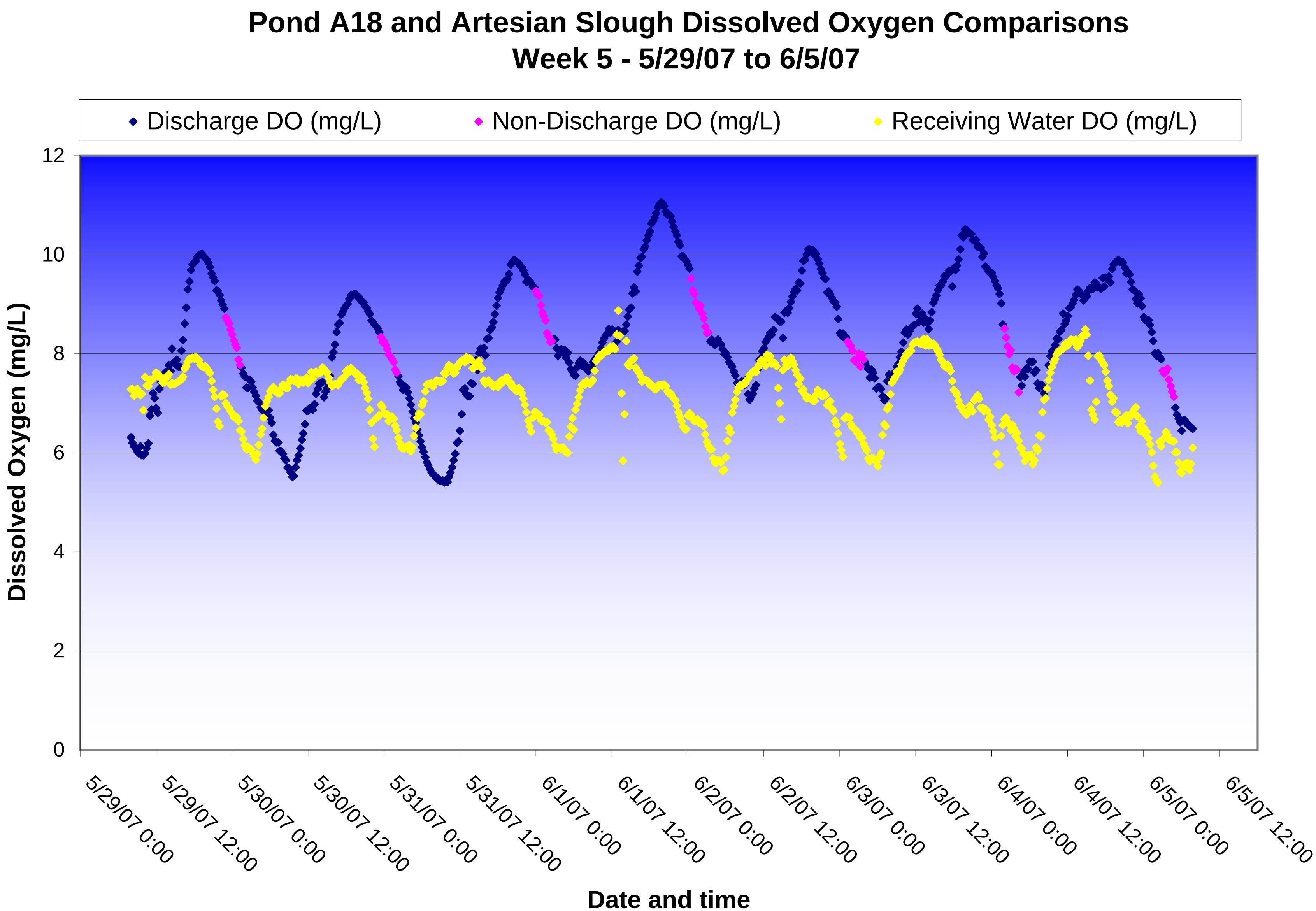
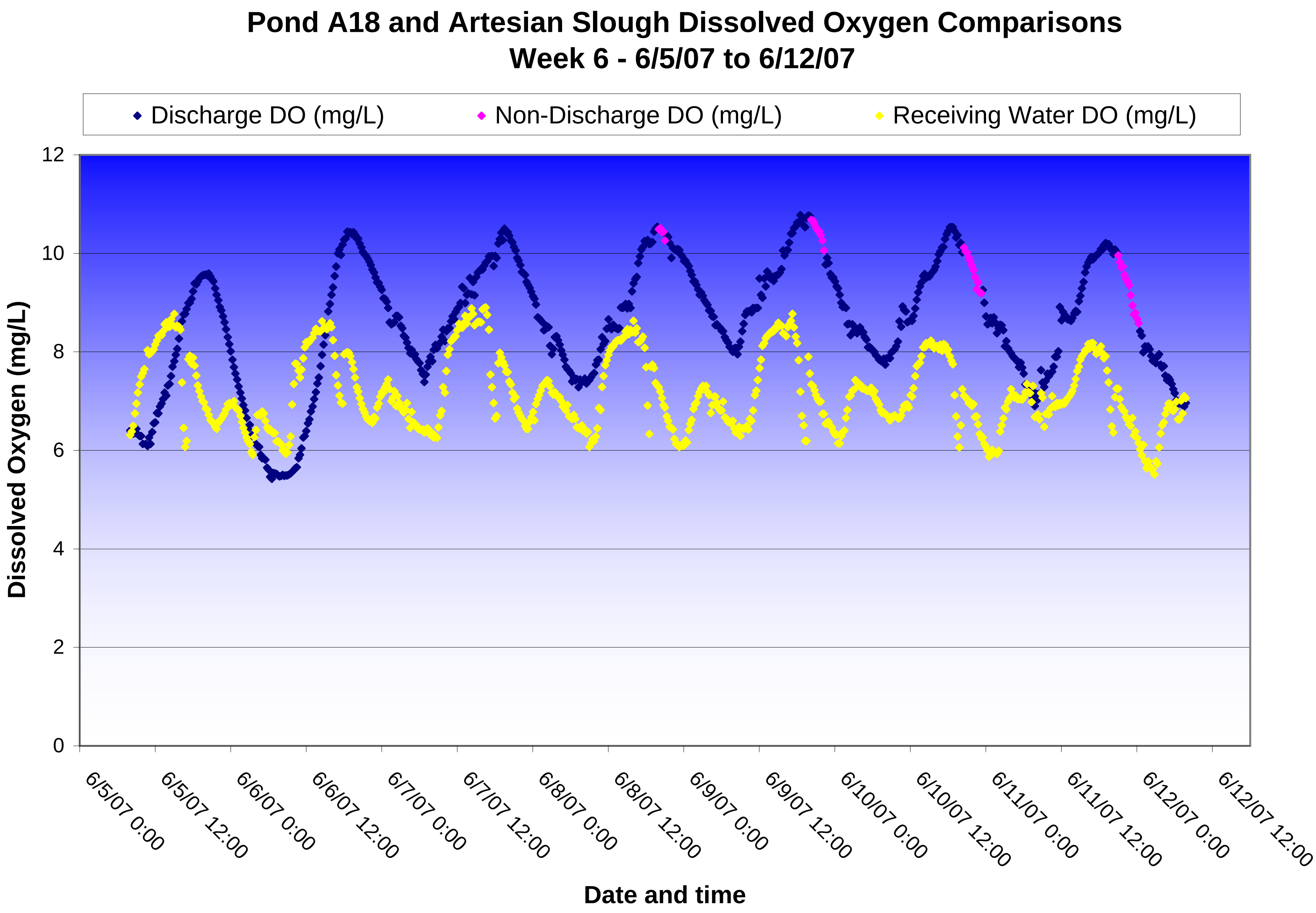
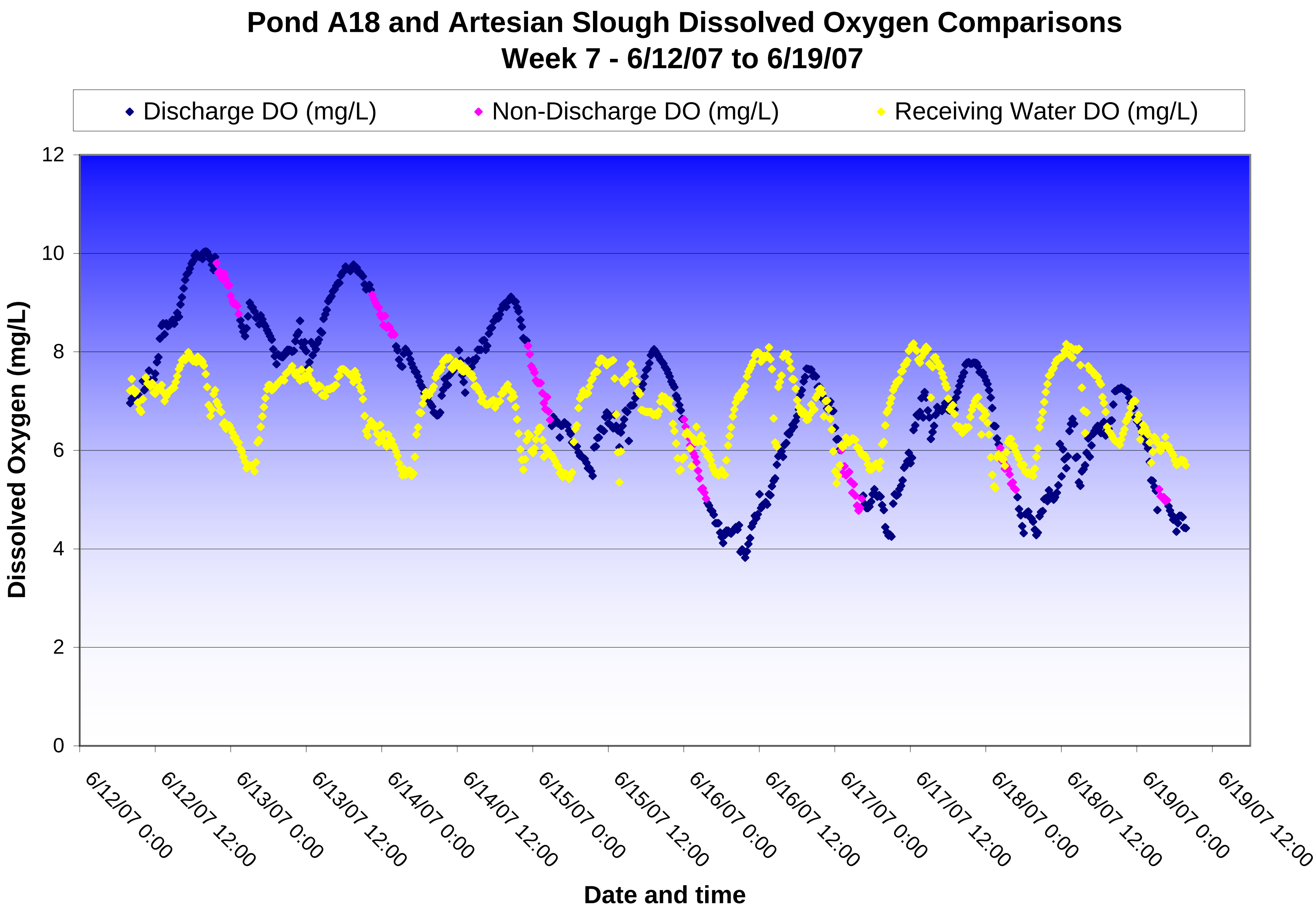
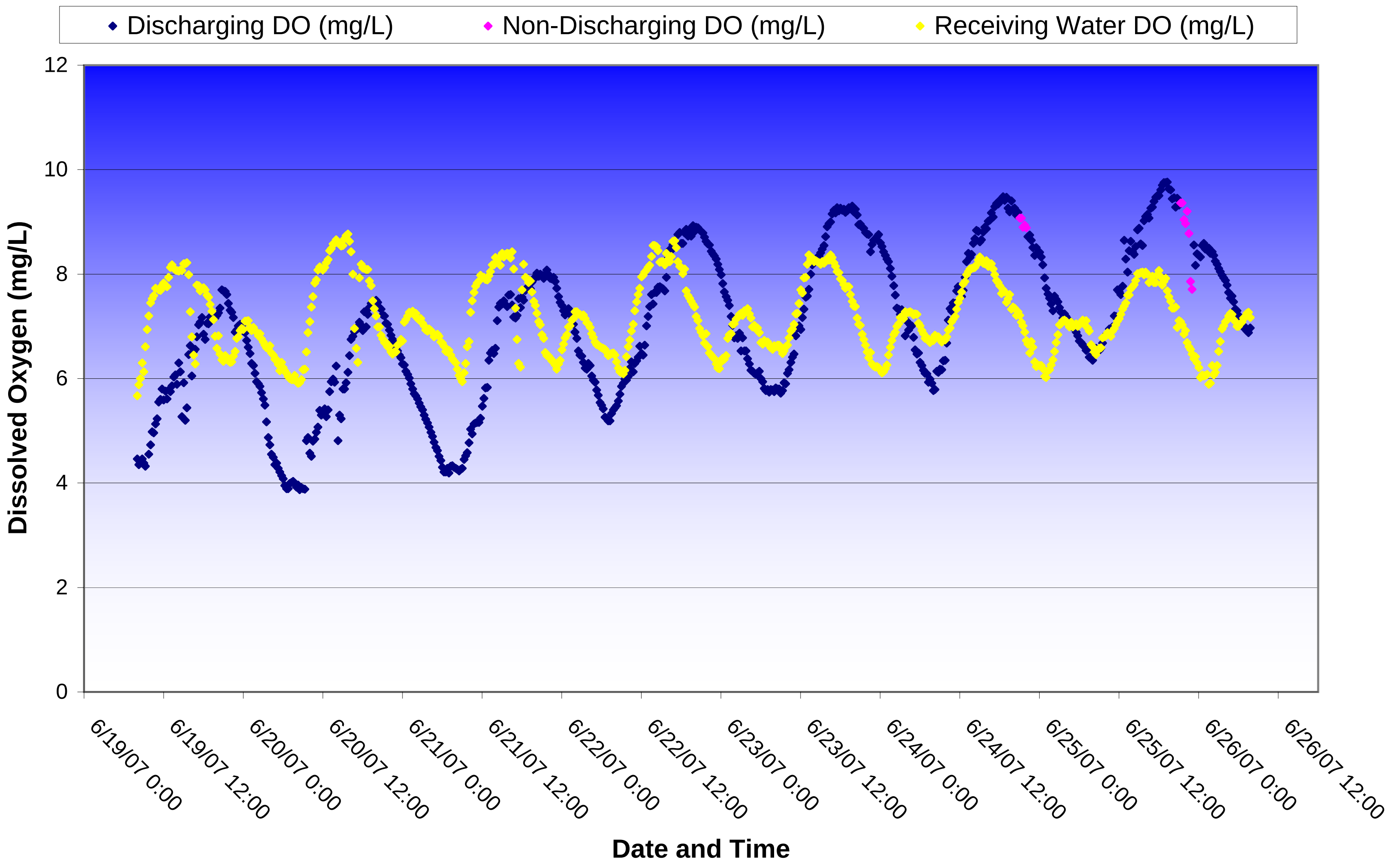
5/29/07 12:00
Date and Time

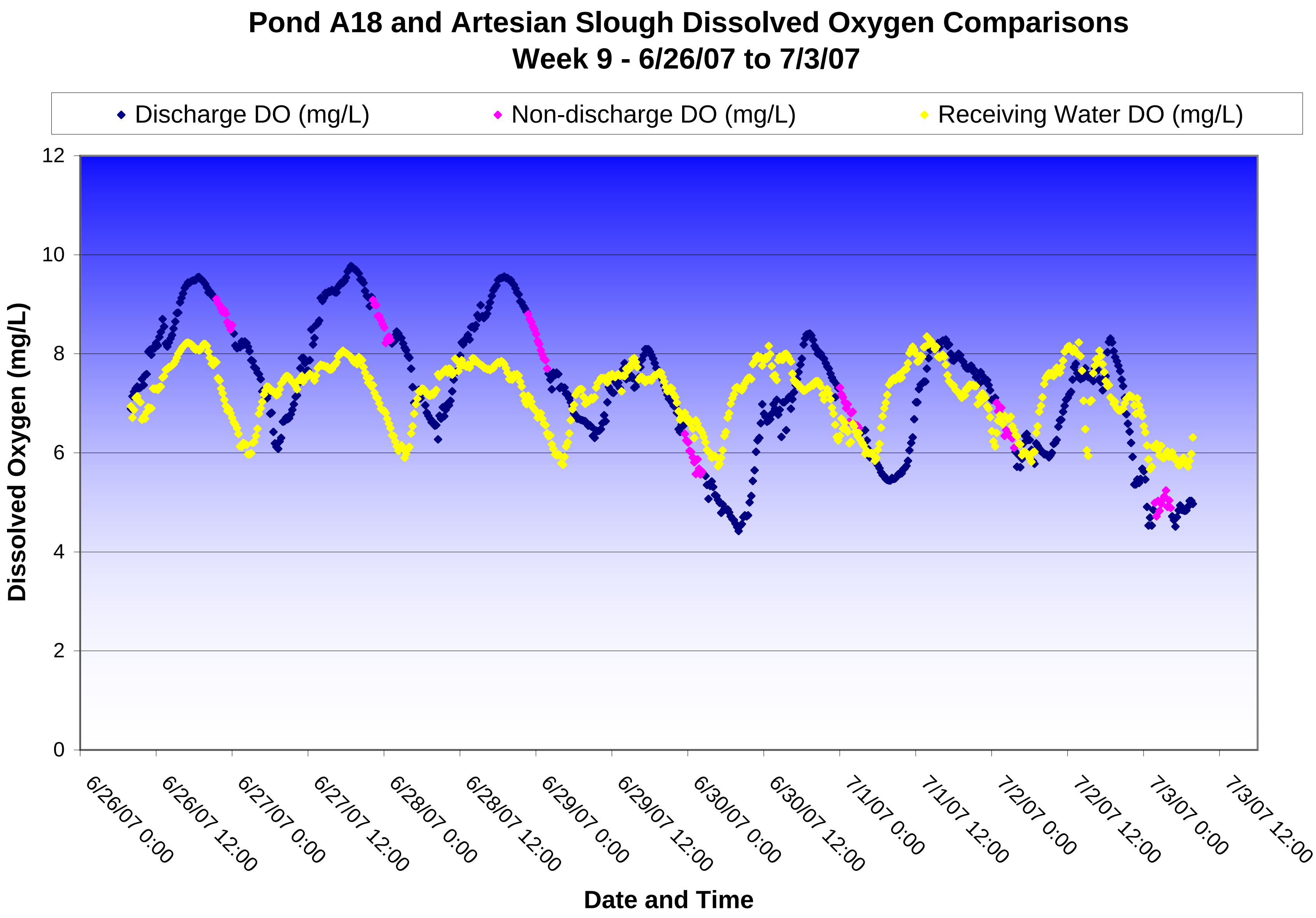

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 5 - 5/29/07 to 6/5/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
5/29/07 0:00
5/29/07 12:00
5/30/07 0:00
5/30/07 12:00
5/31/07 0:00
5/31/07 12:00
6/1/07 0:00
6/1/07 12:00
6/2/07 0:00
6/2/07 12:00
6/3/07 0:00
6/3/07 12:00
6/4/07 0:00
6/4/07 12:00
6/5/07 0:00
6/5/07 12:00
Date and time

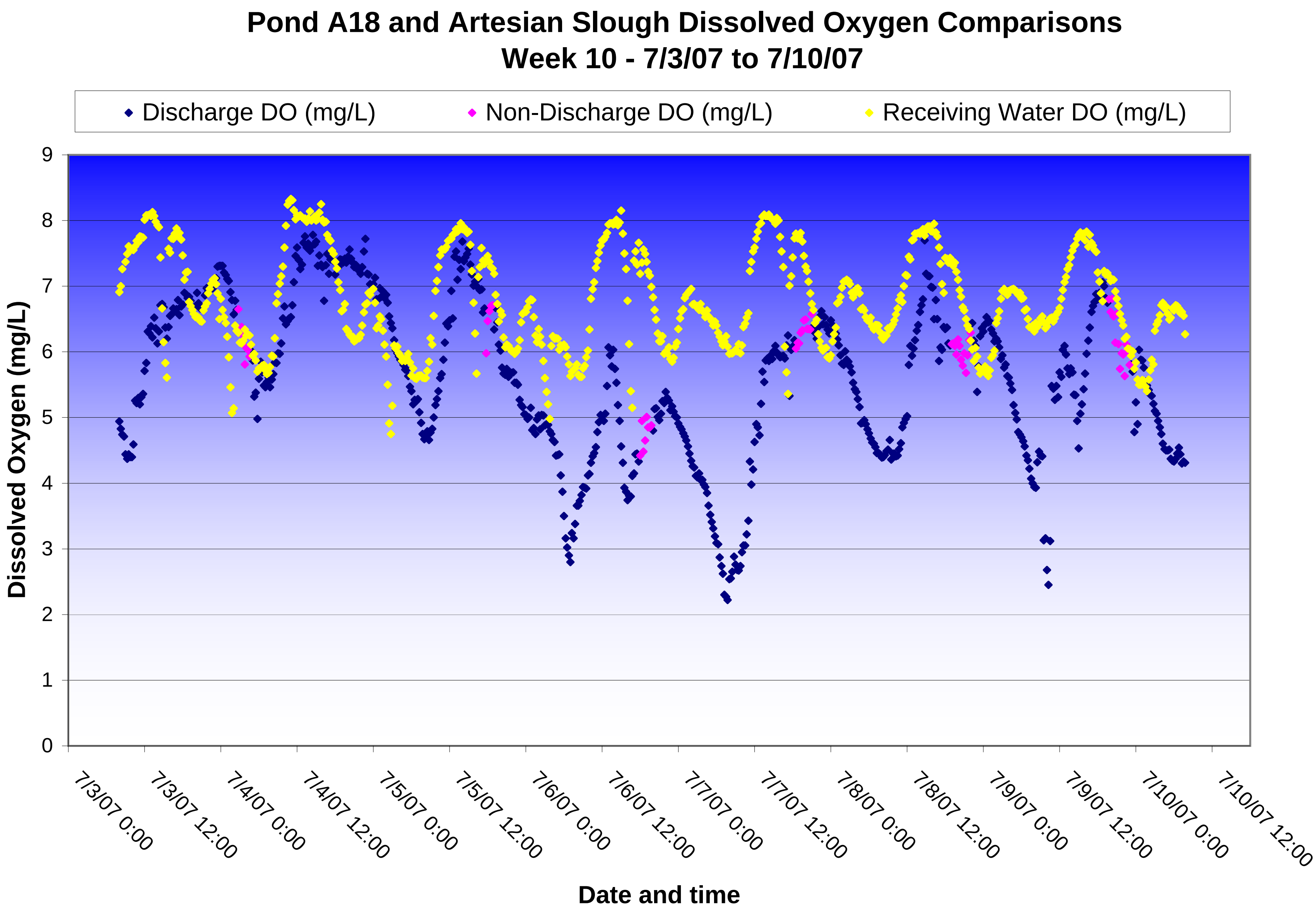

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 6 - 6/5/07 to 6/12/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
6/5/07 0:00
6/5/07 12:00
6/6/07 0:00
6/6/07 12:00
6/7/07 0:00
6/7/07 12:00
6/8/07 0:00
6/8/07 12:00
6/9/07 0:00
6/9/07 12:00
6/10/07 0:00
6/10/07 12:00
6/11/07 0:00
6/11/07 12:00
6/12/07 0:00
6/12/07 12:00
Date and time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 7 - 6/12/07 to 6/19/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
6/12/07 0:00
6/12/07 12:00
6/13/07 0:00
6/13/07 12:00
6/14/07 0:00
6/14/07 12:00
6/15/07 0:00
6/15/07 12:00
6/16/07 0:00
6/16/07 12:00
6/17/07 0:00
6/17/07 12:00
6/18/07 0:00
6/18/07 12:00
6/19/07 0:00
6/19/07 12:00
Date and time

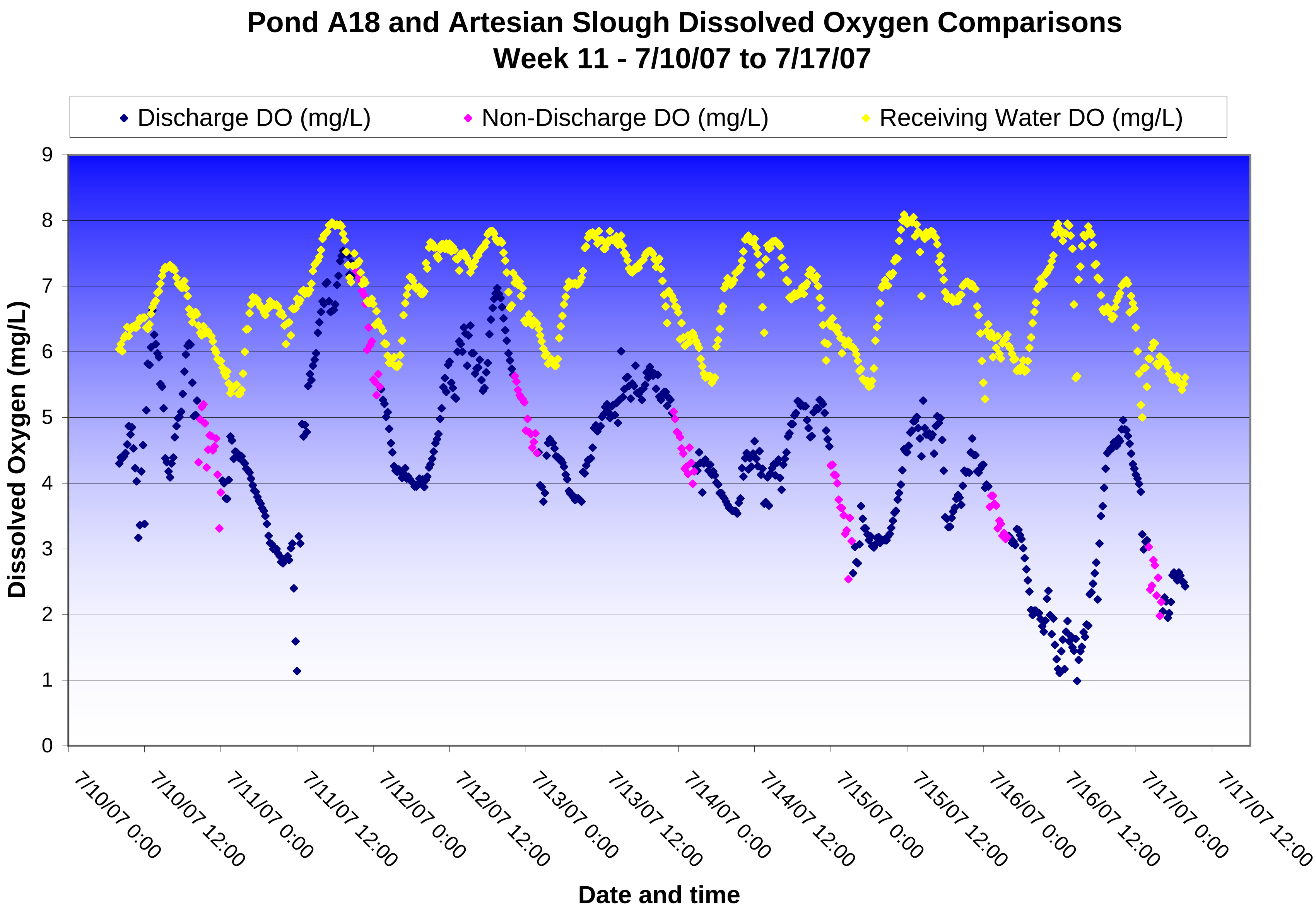
Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 8 - 6/19/07 to 6/26/07



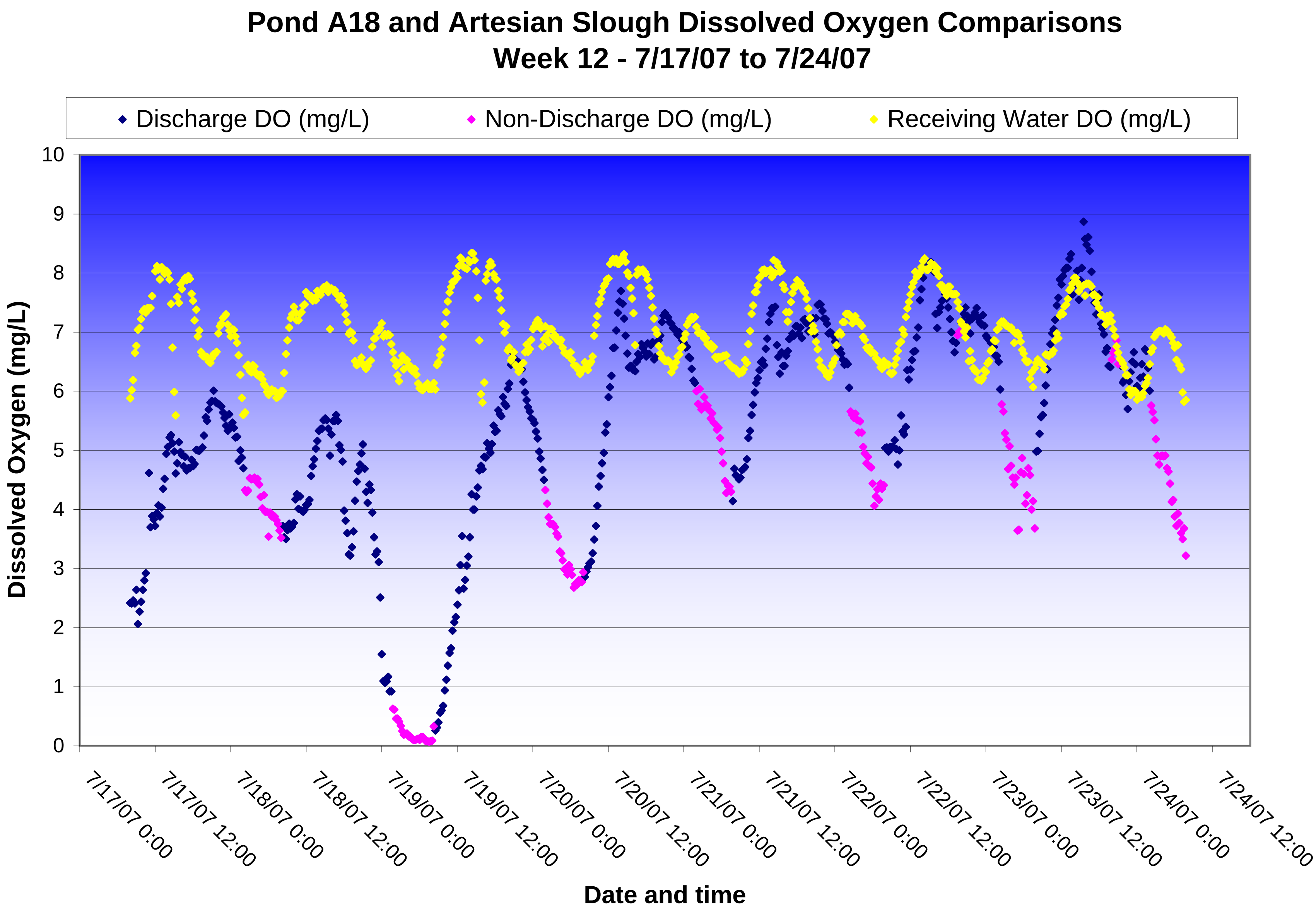

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 9 - 6/26/07 to 7/3/07
Discharge DO (mg/L)
Non-discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
12
10
8
6
4
2
0
6/26/07 0:00
6/26/07 12:00
6/27/07 0:00
6/27/07 12:00
6/28/07 0:00
6/28/07 12:00
6/29/07 0:00
6/29/07 12:00
6/30/07 0:00
6/30/07 12:00
7/1/07 0:00
7/1/07 12:00
7/2/07 0:00
7/2/07 12:00
7/3/07 0:00
7/3/07 12:00
Date and Time



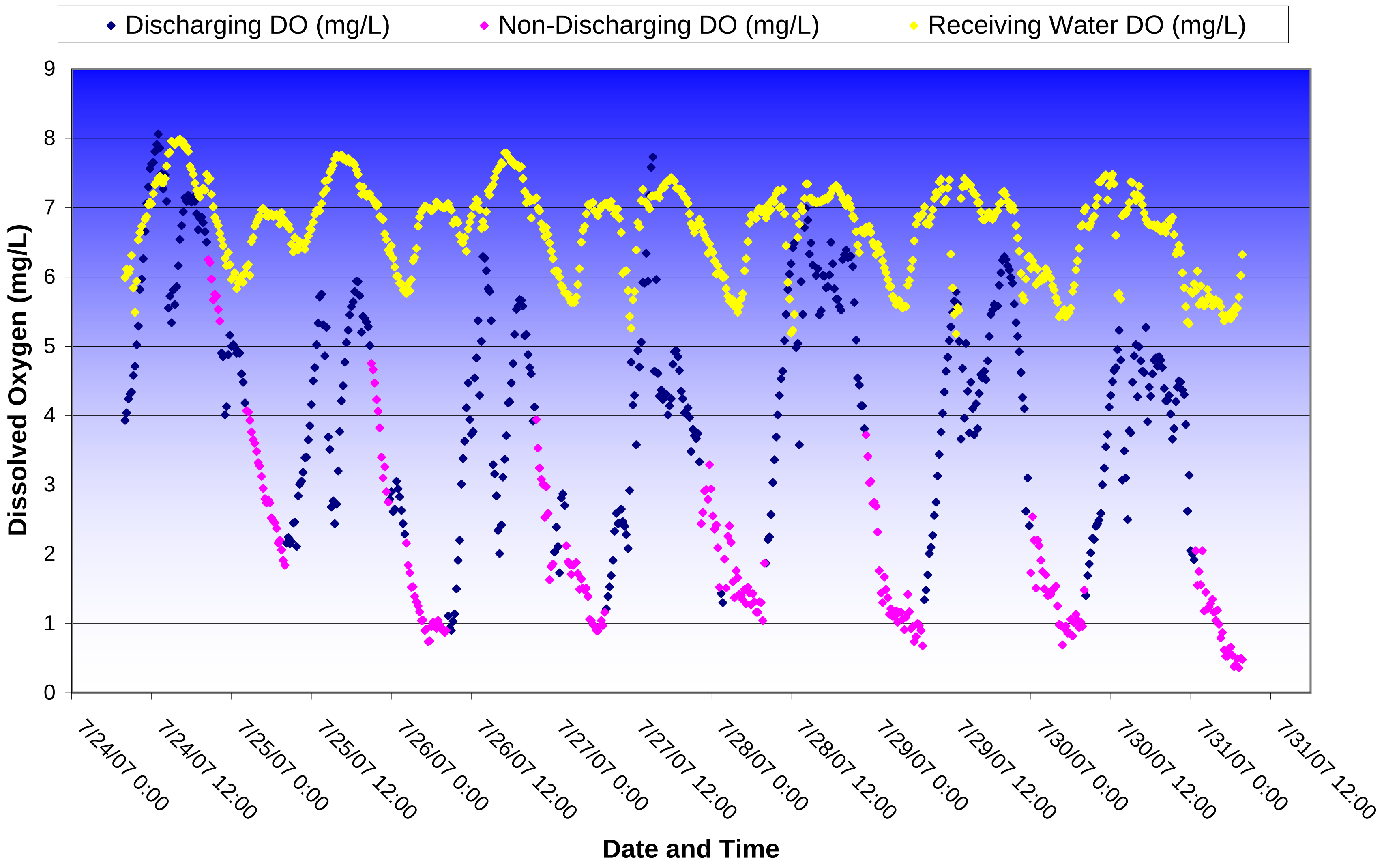
Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 10 - 7/3/07 to 7/10/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
9
7/3/07 0:00
7/3/07 12:00
7/4/07 0:00
7/4/07 12:00
7/5/07 0:00
7/5/07 12:00
7/6/07 0:00
7/6/07 12:00
7/7/07 0:00
7/7/07 12:00
7/8/07 0:00
7/8/07 12:00
7/9/07 0:00
7/9/07 12:00
7/10/07 0:00
7/10/07 12:00
Date and time

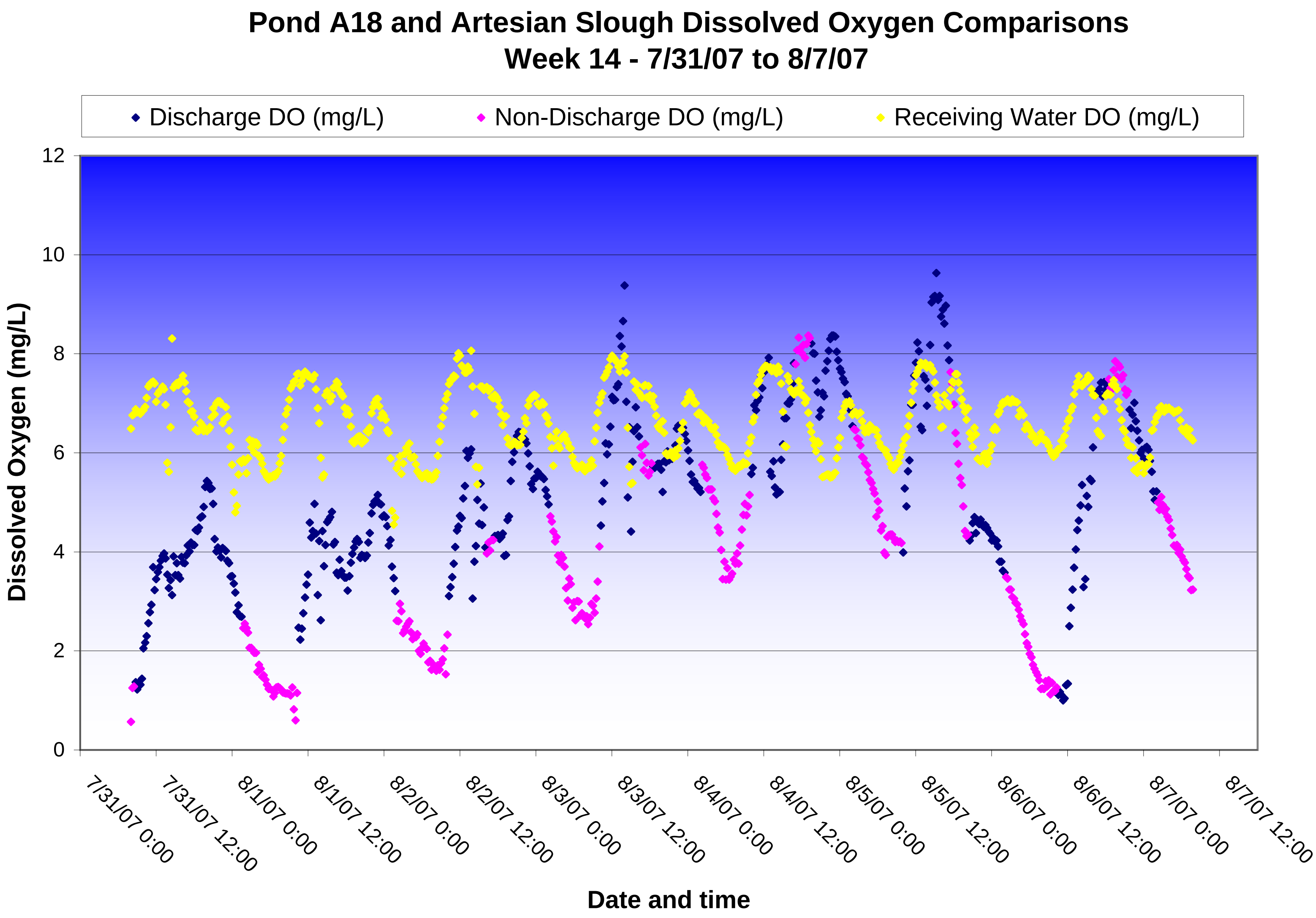


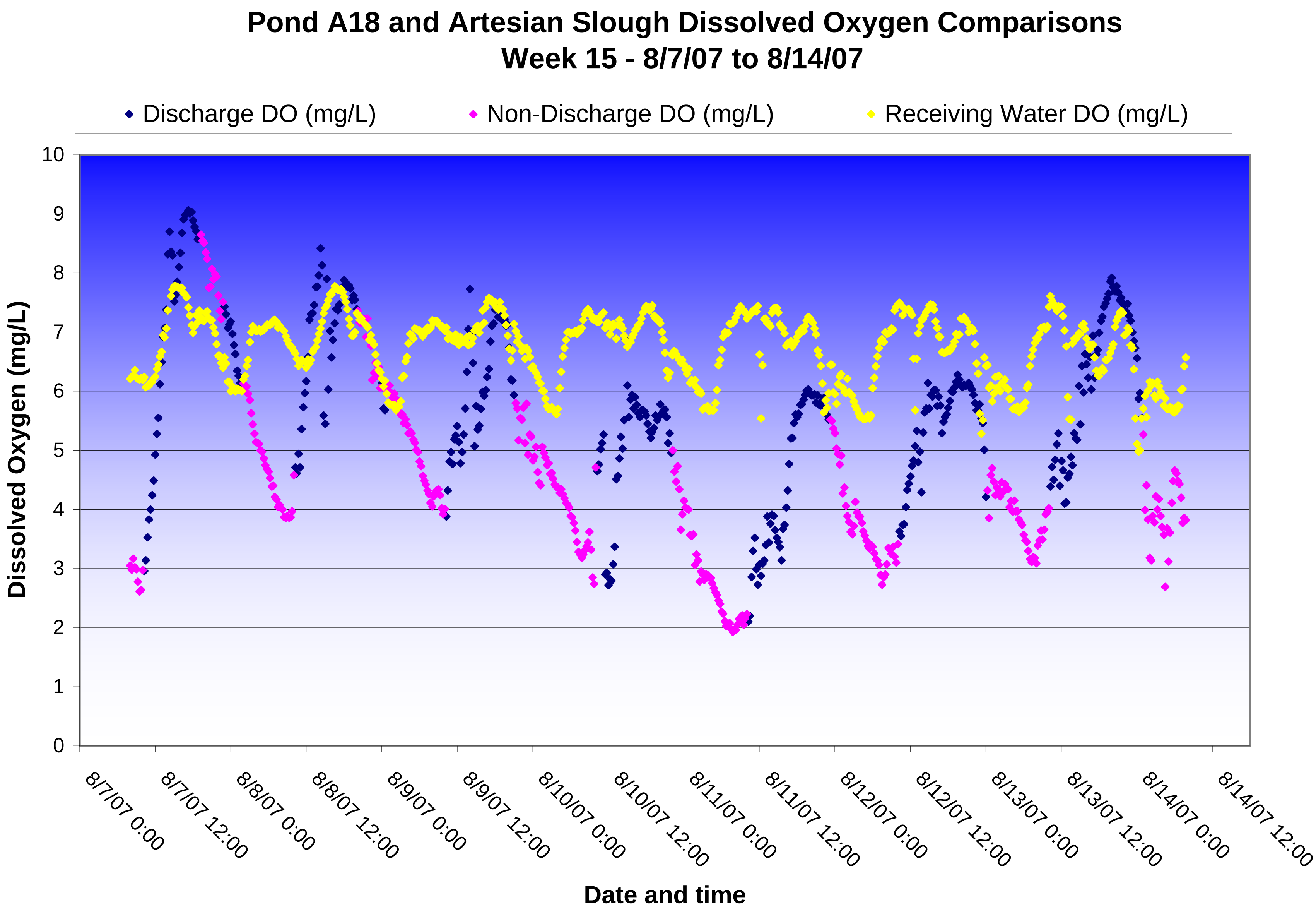
Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 11 - 7/10/07 to 7/17/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
9
7/10/07 0:00
7/10/07 12:00
7/11/07 0:00
7/11/07 12:00
7/12/07 0:00
7/12/07 12:00
7/13/07 0:00
7/13/07 12:00
7/14/07 0:00
7/14/07 12:00
7/15/07 0:00
7/15/07 12:00
7/16/07 0:00
7/16/07 12:00
7/17/07 0:00
7/17/07 12:00
Date and time

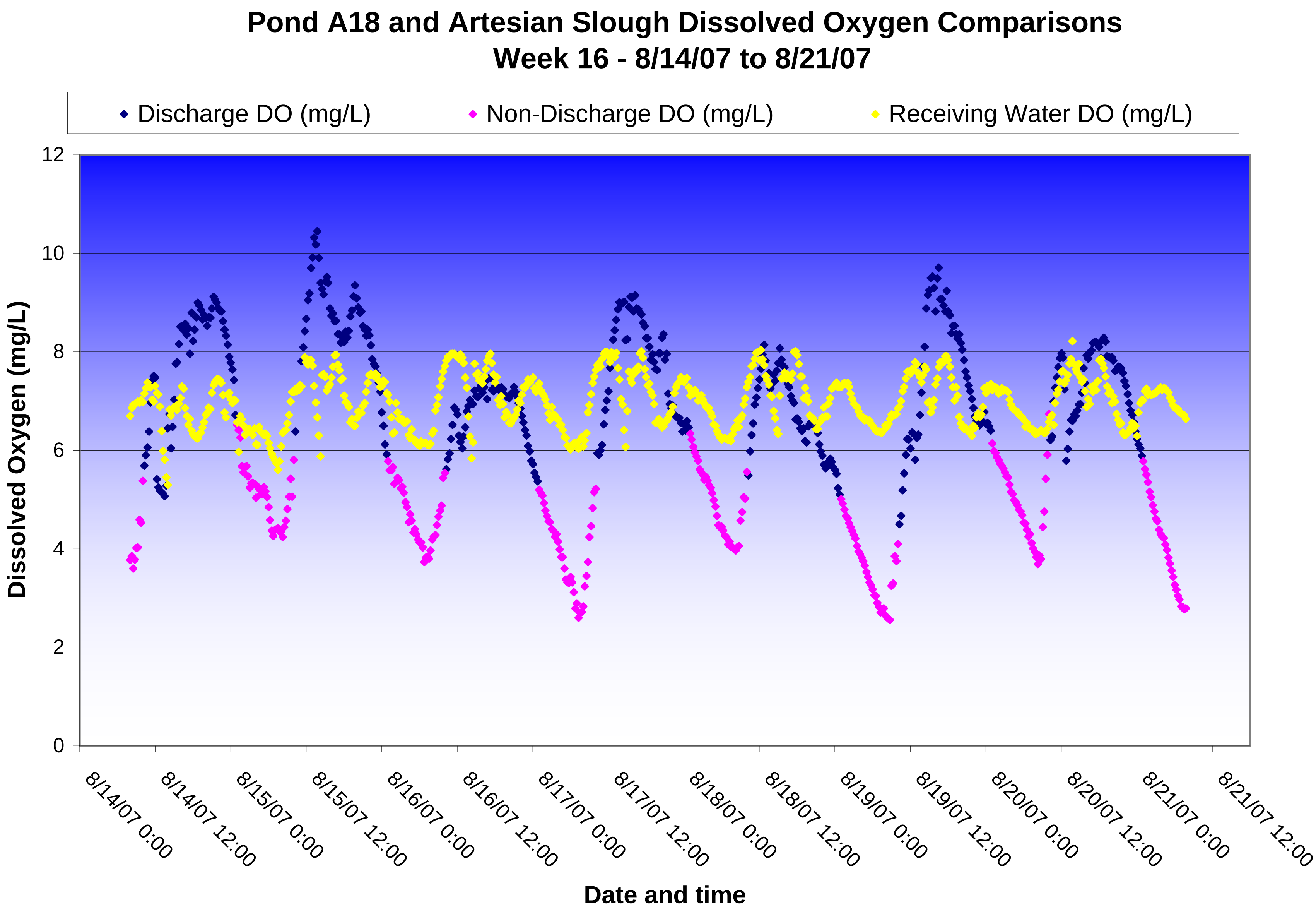

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 12 - 7/17/07 to 7/24/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
9
10
7/17/07 0:00
7/17/07 12:00
7/18/07 0:00
7/18/07 12:00
7/19/07 0:00
7/19/07 12:00
7/20/07 0:00
7/20/07 12:00
7/21/07 0:00
7/21/07 12:00
7/22/07 0:00
7/22/07 12:00
7/23/07 0:00
7/23/07 12:00
7/24/07 0:00
7/24/07 12:00
Date and time

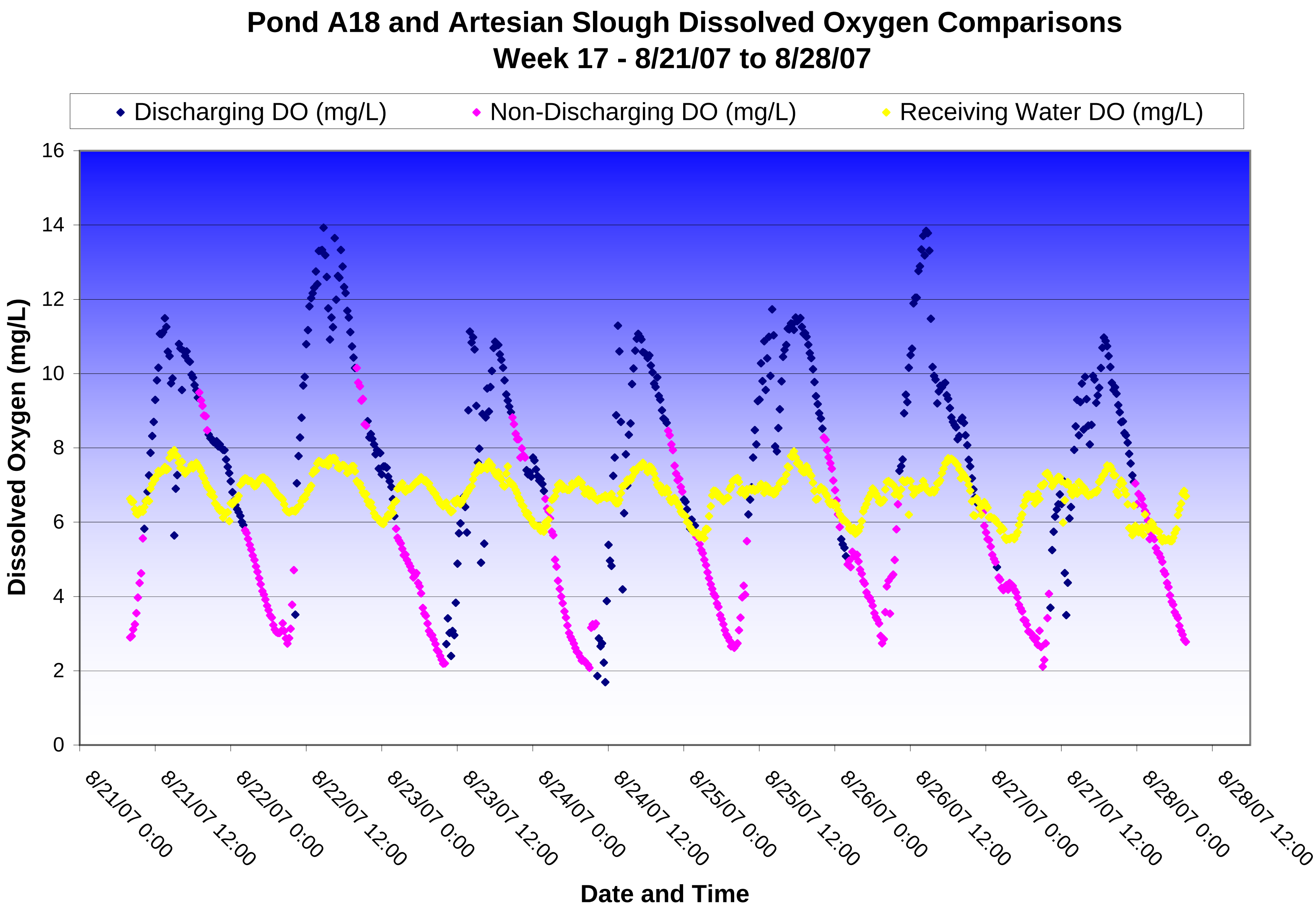
Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 13 - 7/24/07 to 7/31/07

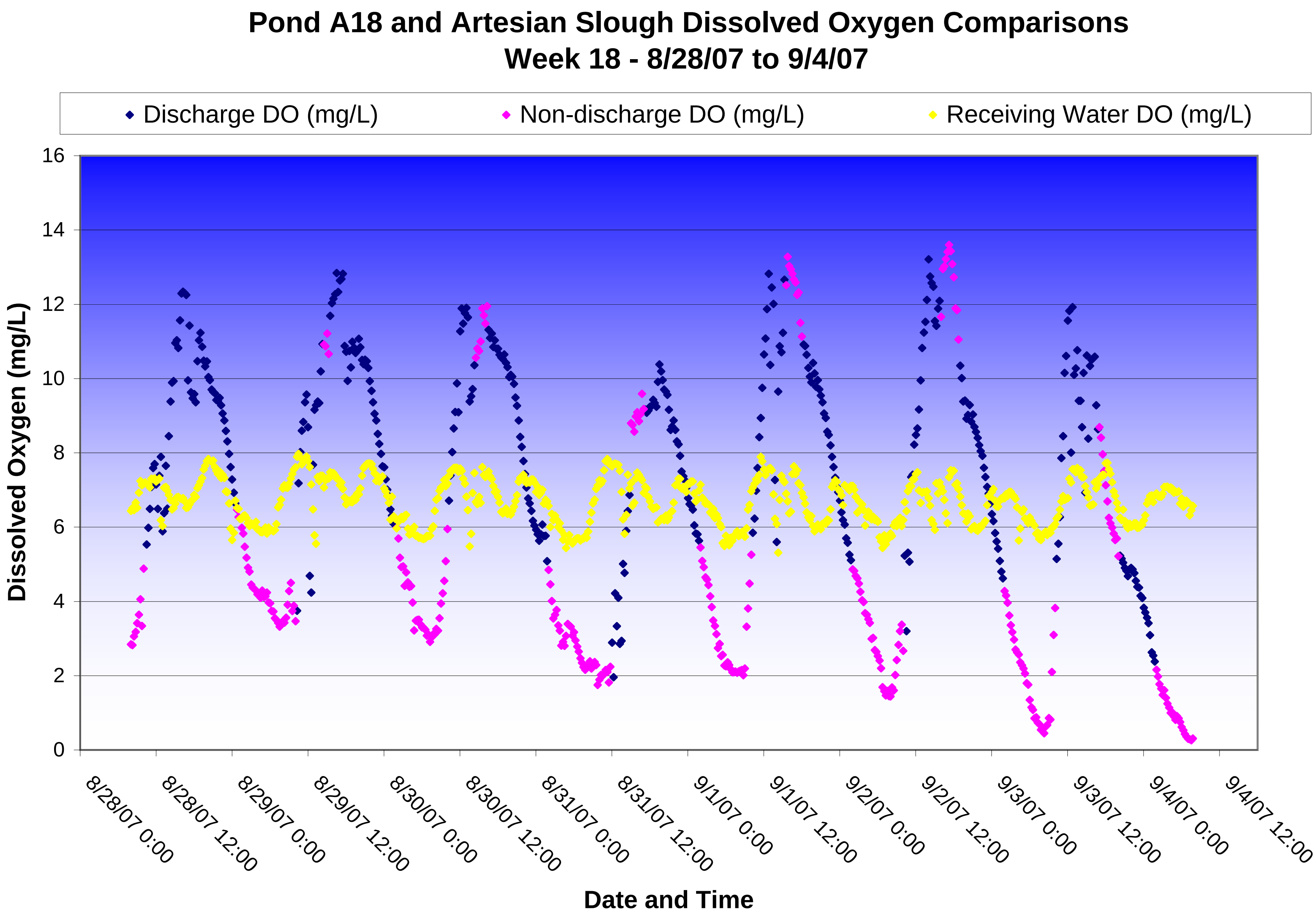


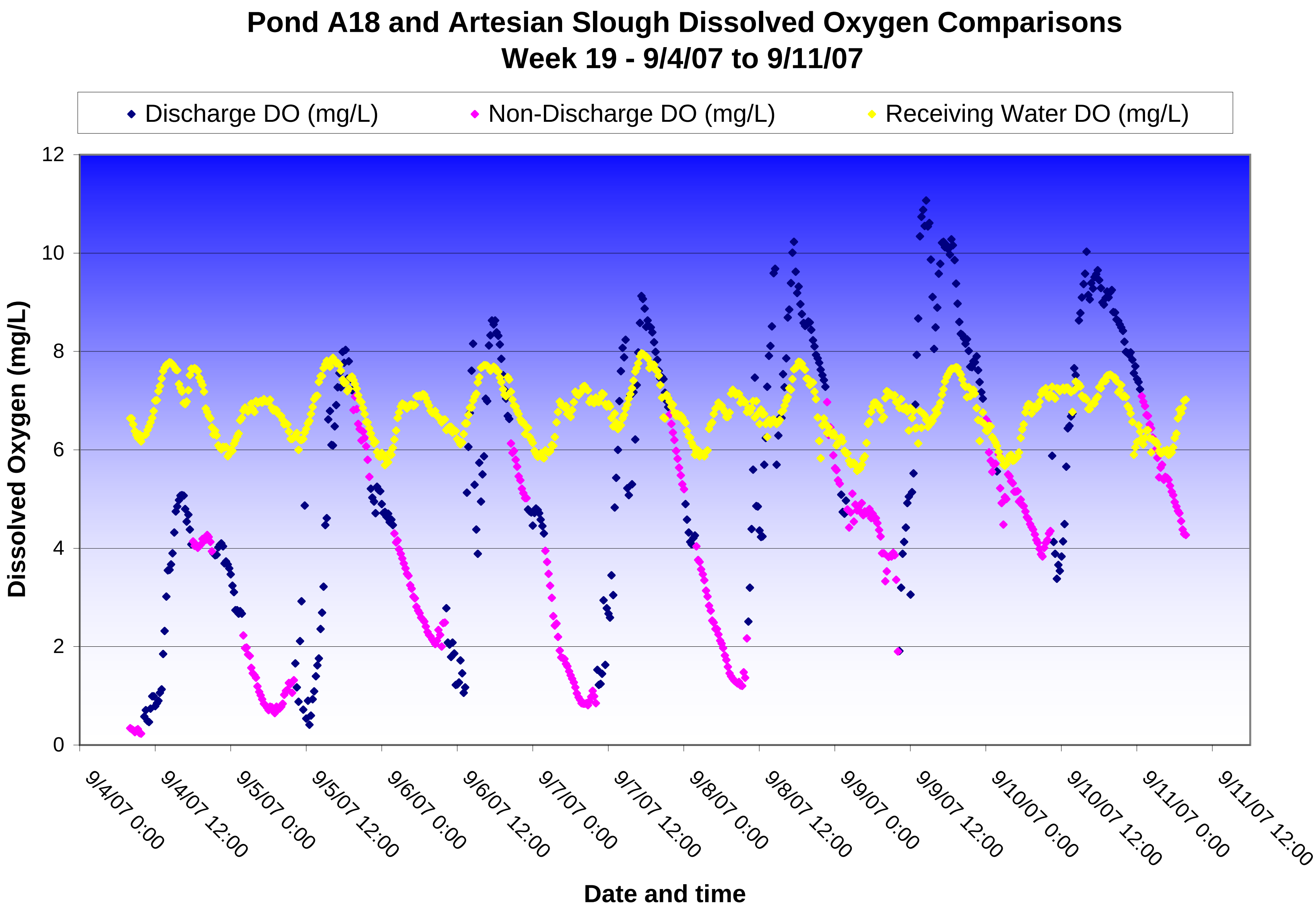

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 14 - 7/31/07 to 8/7/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
7/31/07 0:00
7/31/07 12:00
8/1/07 0:00
8/1/07 12:00
8/2/07 0:00
8/2/07 12:00
8/3/07 0:00
8/3/07 12:00
8/4/07 0:00
8/4/07 12:00
8/5/07 0:00
8/5/07 12:00
8/6/07 0:00
8/6/07 12:00
8/7/07 0:00
8/7/07 12:00
Date and time

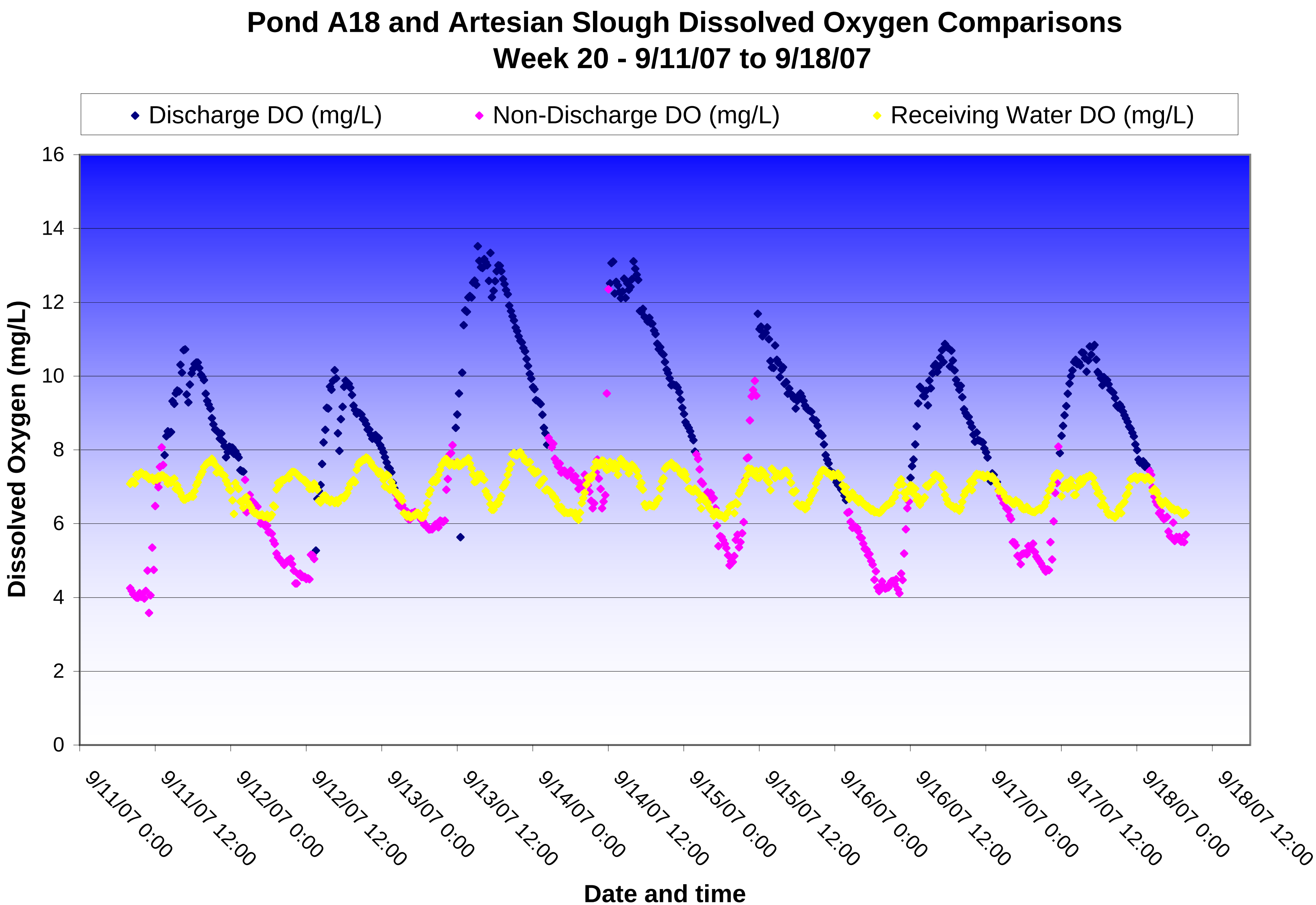

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 15 - 8/7/07 to 8/14/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
9
10
8/7/07 0:00
8/7/07 12:00
8/8/07 0:00
8/8/07 12:00
8/9/07 0:00
8/9/07 12:00
8/10/07 0:00
8/10/07 12:00
8/11/07 0:00
8/11/07 12:00
8/12/07 0:00
8/12/07 12:00
8/13/07 0:00
8/13/07 12:00
8/14/07 0:00
8/14/07 12:00
Date and time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 16 - 8/14/07 to 8/21/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
8/14/07 0:00
8/14/07 12:00
8/15/07 0:00
8/15/07 12:00
8/16/07 0:00
8/16/07 12:00
8/17/07 0:00
8/17/07 12:00
8/18/07 0:00
8/18/07 12:00
8/19/07 0:00
8/19/07 12:00
8/20/07 0:00
8/20/07 12:00
8/21/07 0:00
8/21/07 12:00
Date and time

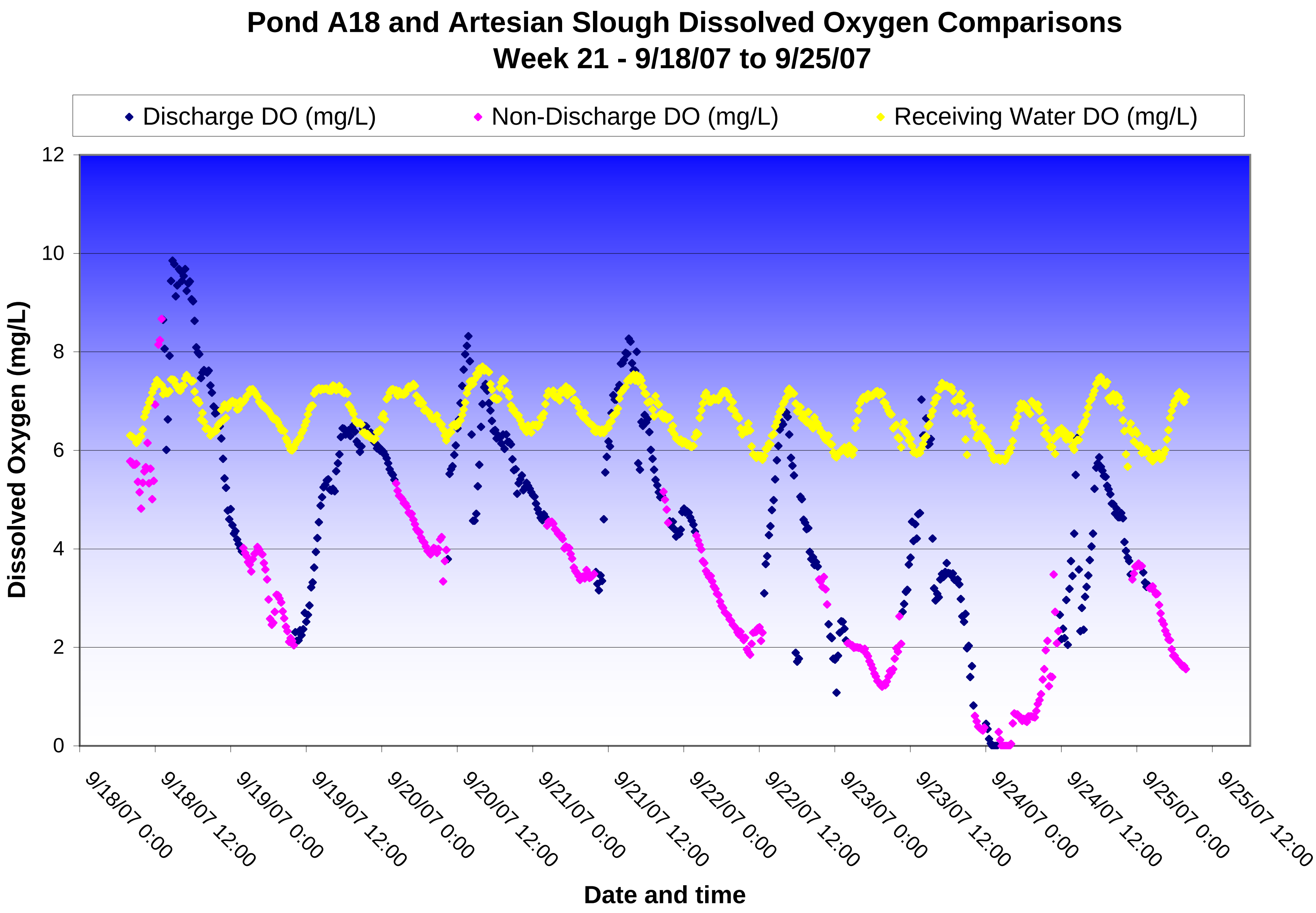

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 17 - 8/21/07 to 8/28/07
Discharging DO (mg/L)
Non-Discharging DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
16
8/21/07 0:00
8/21/07 12:00
8/22/07 0:00
8/22/07 12:00
8/23/07 0:00
8/23/07 12:00
8/24/07 0:00
8/24/07 12:00
8/25/07 0:00
8/25/07 12:00
8/26/07 0:00
8/26/07 12:00
8/27/07 0:00
8/27/07 12:00
8/28/07 0:00
8/28/07 12:00
Date and Time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 18 - 8/28/07 to 9/4/07
Discharge DO (mg/L)
Non-discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
16
8/28/07 0:00
8/28/07 12:00
8/29/07 0:00
8/29/07 12:00
8/30/07 0:00
8/30/07 12:00
8/31/07 0:00
8/31/07 12:00
9/1/07 0:00
9/1/07 12:00
9/2/07 0:00
9/2/07 12:00
9/3/07 0:00
9/3/07 12:00
9/4/07 0:00
9/4/07 12:00
Date and Time

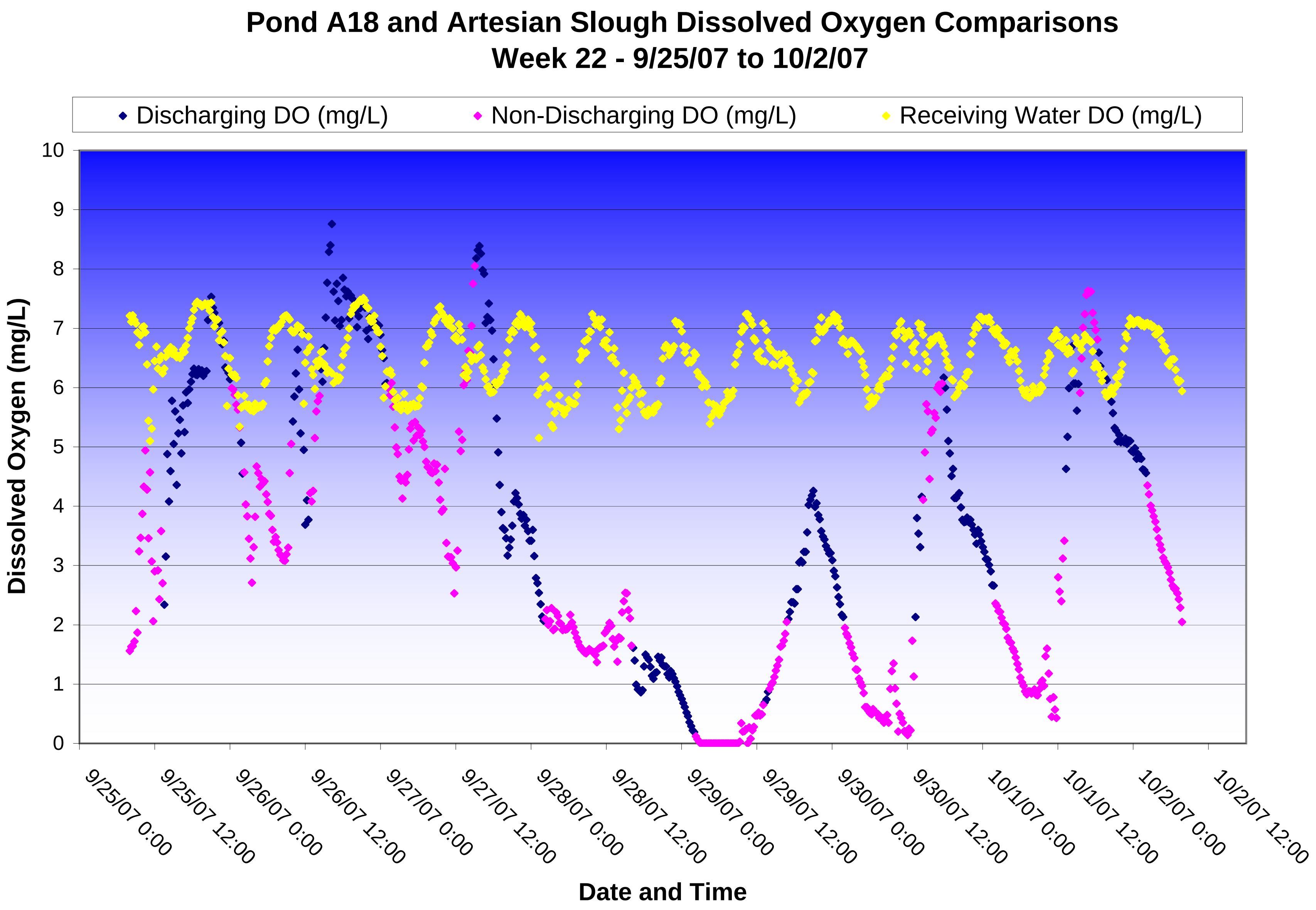

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 19 - 9/4/07 to 9/11/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
9/4/07 0:00
9/4/07 12:00
9/5/07 0:00
9/5/07 12:00
9/6/07 0:00
9/6/07 12:00
9/7/07 0:00
9/7/07 12:00
9/8/07 0:00
9/8/07 12:00
9/9/07 0:00
9/9/07 12:00
9/10/07 0:00
9/10/07 12:00
9/11/07 0:00
9/11/07 12:00
Date and time

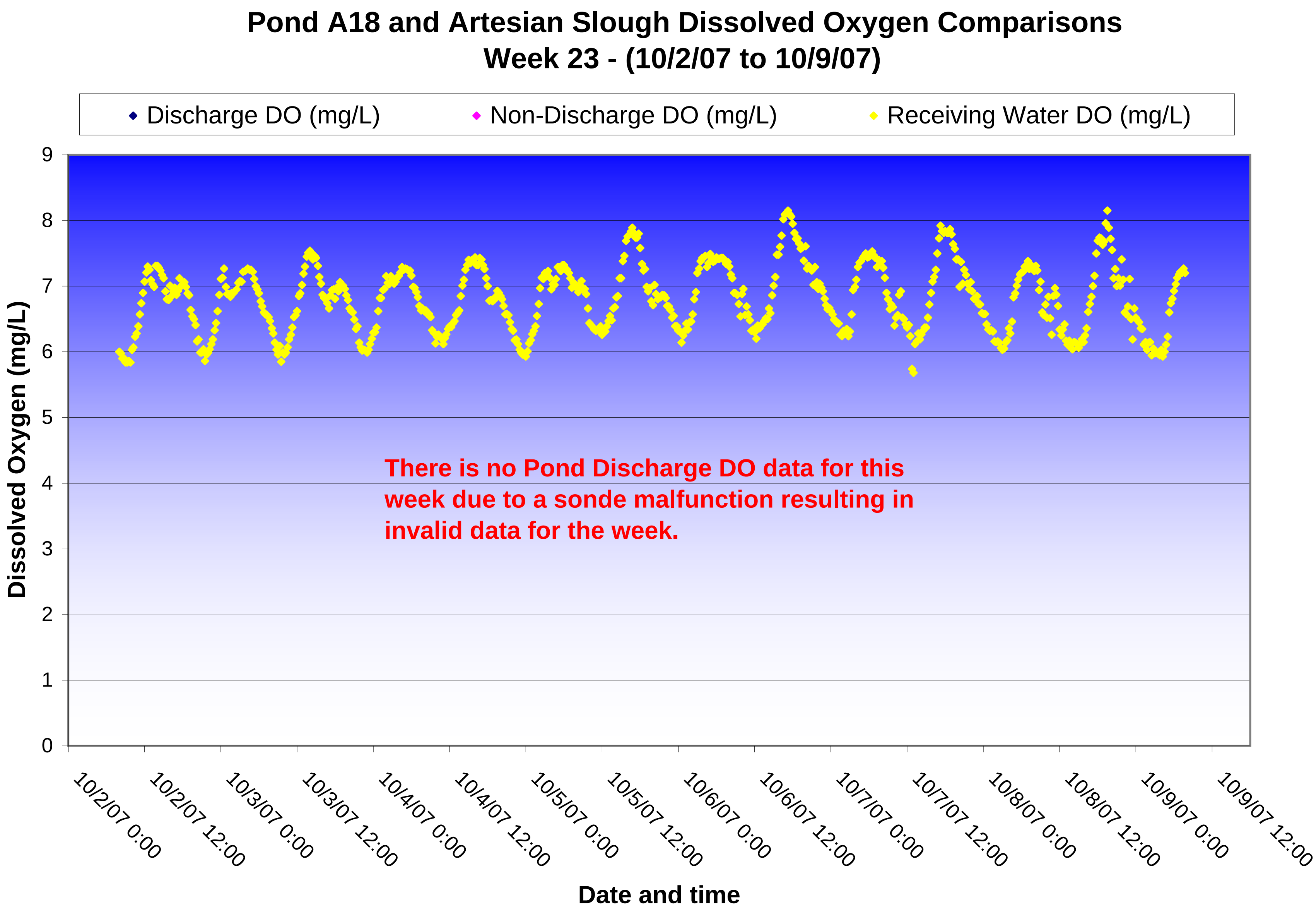


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 20 - 9/11/07 to 9/18/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
16
14
12
10
8
6
4
2
0
9/11/07 0:00
9/11/07 12:00
9/12/07 0:00
9/12/07 12:00
9/13/07 0:00
9/13/07 12:00
9/14/07 0:00
9/14/07 12:00
9/15/07 0:00
9/15/07 12:00
9/16/07 0:00
9/16/07 12:00
9/17/07 0:00
9/17/07 12:00
9/18/07 0:00
9/18/07 12:00
Date and time

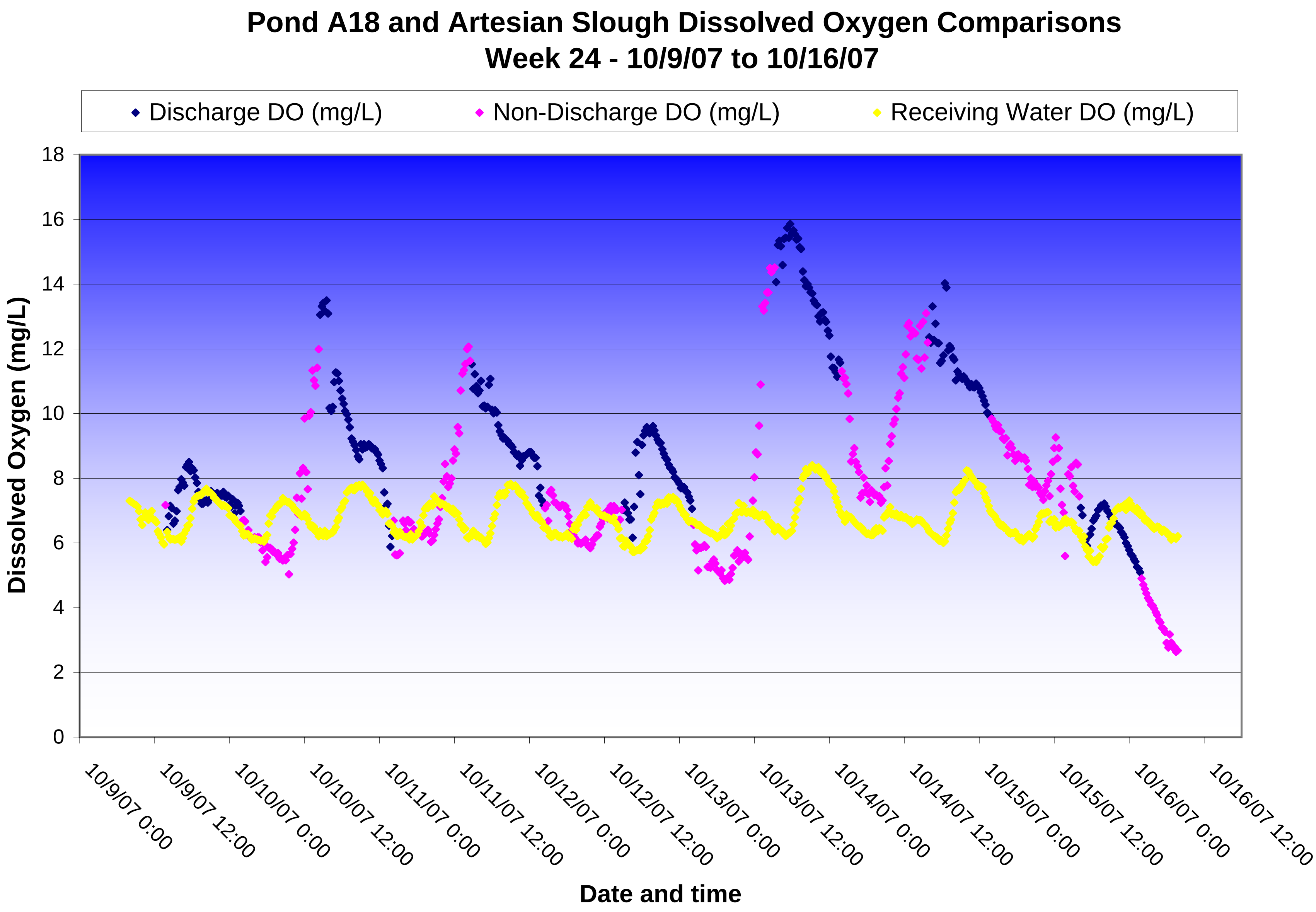


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 21 - 9/18/07 to 9/25/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
9/18/07 0:00
9/18/07 12:00
9/19/07 0:00
9/19/07 12:00
9/20/07 0:00
9/20/07 12:00
9/21/07 0:00
9/21/07 12:00
9/22/07 0:00
9/22/07 12:00
9/23/07 0:00
9/23/07 12:00
9/24/07 0:00
9/24/07 12:00
9/25/07 0:00
9/25/07 12:00
Date and time

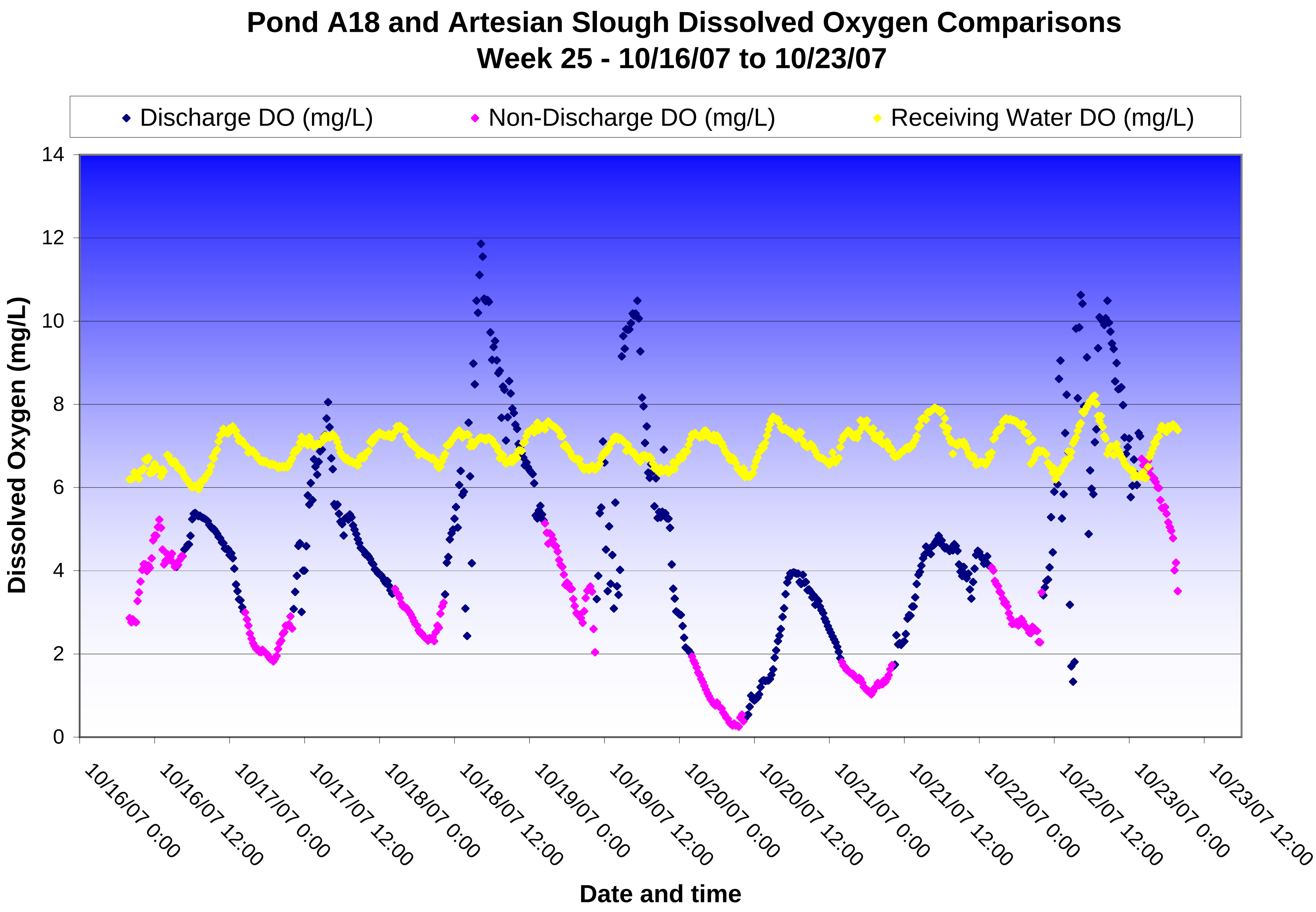

Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 22 - 9/25/07 to 10/2/07
Discharging DO (mg/L)
Non-Discharging DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
10
9
8
7
6
5
4
3
2
1
0
9/25/07 0:00
9/25/07 12:00
9/26/07 0:00
9/26/07 12:00
9/27/07 0:00
9/27/07 12:00
9/28/07 0:00
9/28/07 12:00
9/29/07 0:00
9/29/07 12:00
9/30/07 0:00
9/30/07 12:00
10/1/07 0:00
10/1/07 12:00
10/2/07 0:00
10/2/07 12:00
Date and Time

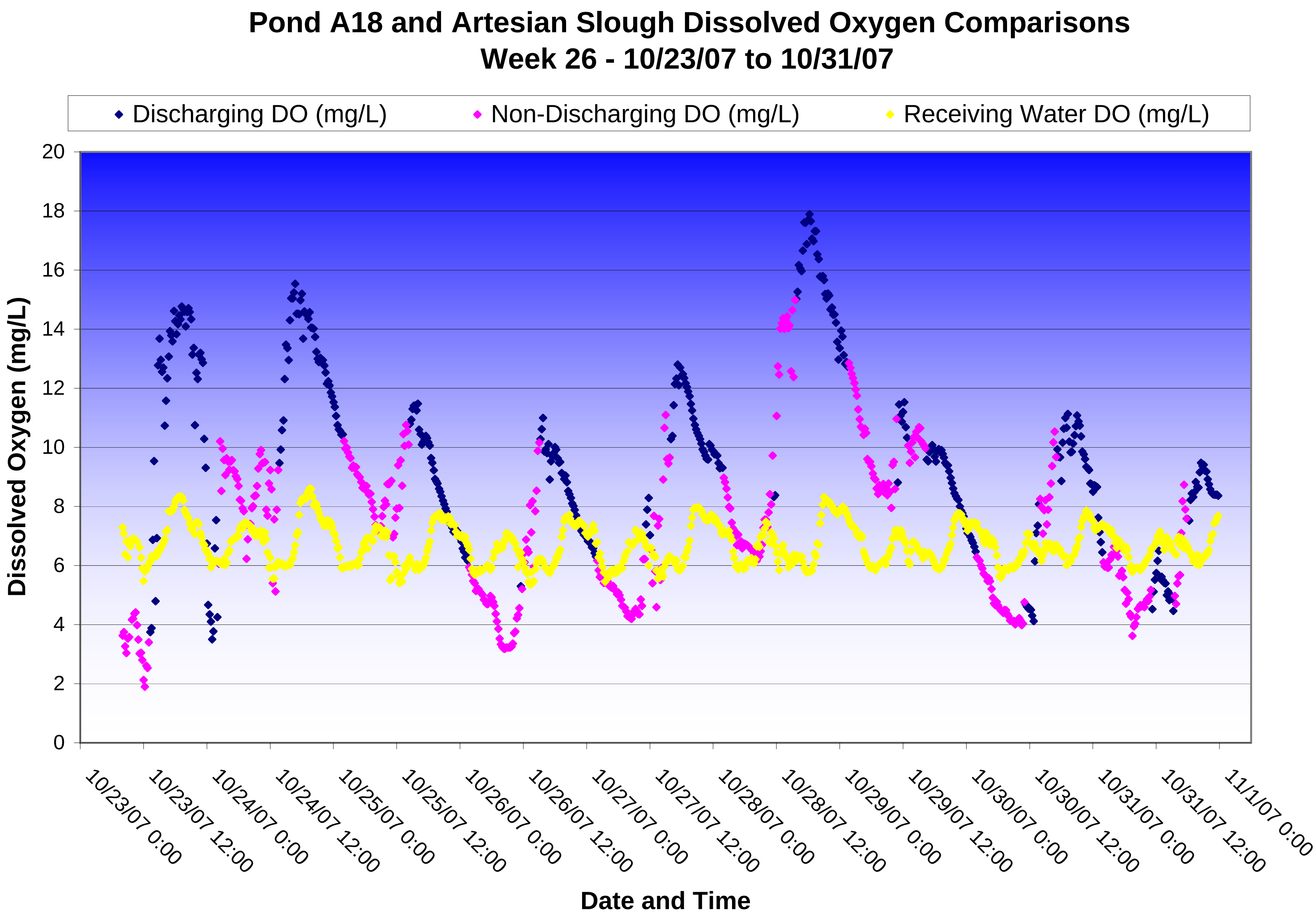


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 23 - (10/2/07 to 10/9/07)
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
1
2
3
4
5
6
7
8
9
There is no Pond Discharge DO data for this week due to a sonde malfunction resulting in invalid data for the week.
10/2/07 0:00
10/2/07 12:00
10/3/07 0:00
10/3/07 12:00
10/4/07 0:00
10/4/07 12:00
10/5/07 0:00
10/5/07 12:00
10/6/07 0:00
10/6/07 12:00
10/7/07 0:00
10/7/07 12:00
10/8/07 0:00
10/8/07 12:00
10/9/07 0:00
10/9/07 12:00
Date and time



Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 24 - 10/9/07 to 10/16/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
16
18
10/9/07 0:00
10/9/07 12:00
10/10/07 0:00
10/10/07 12:00
10/11/07 0:00
10/11/07 12:00
10/12/07 0:00
10/12/07 12:00
10/13/07 0:00
10/13/07 12:00
10/14/07 0:00
10/14/07 12:00
10/15/07 0:00
10/15/07 12:00
10/16/07 0:00
10/16/07 12:00
Date and time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 25 - 10/16/07 to 10/23/07
Discharge DO (mg/L)
Non-Discharge DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
10/16/07 0:00
10/16/07 12:00
10/17/07 0:00
10/17/07 12:00
10/18/07 0:00
10/18/07 12:00
10/19/07 0:00
10/19/07 12:00
10/20/07 0:00
10/20/07 12:00
10/21/07 0:00
10/21/07 12:00
10/22/07 0:00
10/22/07 12:00
10/23/07 0:00
10/23/07 12:00
Date and time


Pond A18 and Artesian Slough Dissolved Oxygen Comparisons
Week 26 - 10/23/07 to 10/31/07
Discharging DO (mg/L)
Non-Discharging DO (mg/L)
Receiving Water DO (mg/L)
Dissolved Oxygen (mg/L)
0
2
4
6
8
10
12
14
16
18
20
10/23/07 0:00
10/23/07 12:00
10/24/07 0:00
10/24/07 12:00
10/25/07 0:00
10/25/07 12:00
10/26/07 0:00
10/26/07 12:00
10/27/07 0:00
10/27/07 12:00
10/28/07 0:00
10/28/07 12:00
10/29/07 0:00
10/29/07 12:00
10/30/07 0:00
10/30/07 12:00
10/31/07 0:00
10/31/07 12:00
11/1/07 0:00
Date and Time

Appendix 2. Monthly Discrete Depth-Profile Measurements of Water Quality at Four Transect Sites in Artesian Slough.

MAY - Pond A18 Discrete Receiving Water Quality Monitoring.

Low tide: 7:33am - flooding. Pond A18 discharging.

DateTime M/D/Y	Temp C	SpCond mS/cm	Salinity ppt	DO % %	DO Conc mg/L	Depth ft	pH	Site	Tidal Height MLLW (ft)	A18 discharge flow cfs	Turbidity NTU	Station
5/29/2007 10:18	22.82	7.64	4.22	74.9	6.29	5.31	7.71	2	2.7	27.6	8.6	A18-Artesian-02
5/29/2007 10:18	23.09	6.13	3.34	75.6	6.36	4.28	7.68	2	2.7	27.6		
5/29/2007 10:19	23.17	5.61	3.04	83.0	6.98	3.19	7.60	2	2.7	27.6		
5/29/2007 10:19	23.42	4.88	2.62	91.5	7.67	2.37	7.50	2	2.7	27.6		
5/29/2007 10:20	23.52	4.34	2.31	93.9	7.87	1.24	7.46	2	2.7	27.6		
5/29/2007 10:20	23.57	3.97	2.10	94.3	7.91	0.35	7.45	2	2.7	27.6	2.7	
5/29/2007 10:38	20.56	22.22	13.42	51.4	4.27	8.26	7.93	4	3.4	25.0	54.0	A18-Artesian-04
5/29/2007 10:38	20.57	22.24	13.42	51.4	4.27	7.06	7.94	4	3.4	25.0		
5/29/2007 10:38	20.57	22.23	13.42	51.5	4.28	5.98	7.94	4	3.4	25.0		
5/29/2007 10:39	20.57	22.23	13.42	51.8	4.31	5.11	7.94	4	3.4	25.0		
5/29/2007 10:39	20.55	22.17	13.38	52.5	4.37	4.16	7.93	4	3.4	25.0		
5/29/2007 10:40	20.64	22.22	13.41	53.1	4.41	3.10	7.95	4	3.4	25.0		
5/29/2007 10:41	20.59	22.19	13.39	52.6	4.37	2.09	7.93	4	3.4	25.0		
5/29/2007 10:42	20.56	22.13	13.36	52.8	4.39	1.00	7.91	4	3.5	25.0		
5/29/2007 10:42	20.60	22.13	13.35	53.0	4.40	0.12	7.91	4	3.5	25.0	39.0	
5/29/2007 10:55	20.83	13.89	8.06	53.8	4.59	7.12	7.63	3	3.8	23.4	26.0	A18-Artesian-03
5/29/2007 10:55	20.86	13.81	8.00	55.6	4.74	6.09	7.63	3	3.8	23.4		
5/29/2007 10:56	20.95	13.52	7.82	59.6	5.08	5.03	7.63	3	3.8	23.4		
5/29/2007 10:56	21.02	13.23	7.64	62.2	5.30	4.02	7.63	3	3.8	23.4		
5/29/2007 10:57	21.54	10.63	6.03	67.7	5.77	3.08	7.60	3	3.9	23.4		
5/29/2007 10:57	22.32	7.14	3.93	78.7	6.69	2.05	7.56	3	3.9	23.4		
5/29/2007 10:58	22.82	6.06	3.30	83.5	7.05	0.32	7.51	3	3.9	23.4	14.0	
5/29/2007 11:10	22.45	20.93	12.55	109.3	8.81	6.47	8.37	1	4.3	22.1	2.8	A18-Artesian-01
5/29/2007 11:10	23.00	15.24	8.88	108.7	8.86	5.32	8.11	1	4.3	22.1		
5/29/2007 11:10	23.50	7.26	3.99	110.2	9.15	4.45	7.90	1	4.3	22.1		
5/29/2007 11:11	23.93	2.90	1.51	106.9	8.94	2.91	7.60	1	4.3	22.1		
5/29/2007 11:11	24.00	1.65	0.83	105.9	8.87	2.23	7.53	1	4.3	22.1		
5/29/2007 11:11	24.05	1.21	0.60	103.2	8.65	0.54	7.45	1	4.3	22.1	2.4	

JUNE - Pond A18 Discrete Receiving Water Quality Monitoring.

Low tide: 12:07pm - ebbing to low slack. Pond A18 discharging.

DateTime M/D/Y	Temp C	SpCond mS/cm	Salinity ppt	DO % %	DO Conc mg/L	Depth ft	pH	Site	Tidal Height MLLW (ft)	A18 discharge flow cfs	Turbidity NTU	Station
6/19/2007 11:28	24.98	13.55	7.81	102.4	8.1	3.312	7.82	1	-0.7	41.1	5.5	A18-Artesian-01
6/19/2007 11:29	25.04	13.27	7.64	104.7	8.28	2.816	7.59	1	-0.7	41.1		
6/19/2007 11:29	25.15	3.661	1.92	105.9	8.63	1.452	7.53	1	-0.7	41.1		
6/19/2007 11:30	25.16	2.36	1.21	106.5	8.72	0.398	7.55	1	-0.7	41.1	3.4	
6/19/2007 11:20	24.92	11.38	6.47	101.6	8.1	3.788	8.1	2	-0.6	40.8	23.2	A18-Artesian-02
6/19/2007 11:20	25.01	10.65	6.02	102.3	8.17	2.598	8.02	2	-0.6	40.8		
6/19/2007 11:21	25.08	7.972	4.41	104.6	8.42	1.444	7.71	2	-0.6	40.8		
6/19/2007 11:21	25.17	5.278	2.84	105.3	8.54	0.091	7.65	2	-0.6	40.8	5.8	
6/19/2007 10:58	24.83	8.026	4.44	84.1	6.8	5.722	7.55	3	-0.5	40.6	38.4	A18-Artesian-03
6/19/2007 10:59	24.84	8.048	4.46	84.1	6.79	4.133	7.53	3	-0.5	40.6		
6/19/2007 10:59	24.85	8.069	4.47	84.8	6.85	3.591	7.52	3	-0.5	40.6		
6/19/2007 10:59	24.86	8.074	4.47	85.3	6.89	2.649	7.52	3	-0.5	40.6		
6/19/2007 11:00	24.87	8.089	4.48	85.9	6.94	1.705	7.52	3	-0.5	40.6		
6/19/2007 11:00	24.89	8.112	4.5	86.7	7	0.334	7.52	3	-0.5	40.6	24.5	
6/19/2007 10:48	24.4	6.504	3.55	60.1	4.92	4.426	7.31	4	-0.3	40.1	412.0	A18-Artesian-04
6/19/2007 10:49	24.48	6.967	3.82	60.3	4.93	3.692	7.33	4	-0.3	40.1		
6/19/2007 10:49	24.49	6.979	3.83	63.6	5.19	2.449	7.33	4	-0.3	40.1		
6/19/2007 10:49	24.51	6.988	3.83	64.8	5.29	0.194	7.34	4	-0.3	40.1	171.0	

JULY - Pond A18 Discrete Receiving Water Quality Monitoring.

Low tide: 10:51am - low slack to flooding. Pond A18 discharging

DateTime M/D/Y	Temp C	SpCond mS/cm	Salinity ppt	DO % %	DO Conc mg/L	Depth ft	pH	Site	Tidal Height MLLW (ft)	A18 discharge flow cfs	Turbidity NTU	Station
7/17/2007 12:05	26.23	1.251	0.62	123.2	9.92	2.775	7.57	1	0	39.6	5.6	A18-Artesian-01
7/17/2007 12:05	26.24	1.24	0.61	125.7	10.12	1.692	7.46	1	0	39.6		
7/17/2007 12:06	26.25	1.236	0.61	127.2	10.24	0.679	7.43	1	0	39.6	9.8	
7/17/2007 11:57	25.44	15.61	9.1	96.8	7.54	3.528	8.03	2	0	39.6	34.5	A18-Artesian-02
7/17/2007 11:58	25.55	14.06	8.12	98.3	7.68	2.153	8.04	2	0	39.6		
7/17/2007 11:58	26.02	7.296	4.01	106.1	8.42	0.811	7.85	2	0	39.6		
7/17/2007 11:58	26.08	4.51	2.4	107.7	8.61	0.216	7.77	2	0	39.6	5.6	
7/17/2007 11:45	25.82	9.933	5.58	94.9	7.48	2.468	7.62	3	-0.3	40.3	56.1	A18-Artesian-03
7/17/2007 11:45	25.81	9.917	5.57	95.4	7.53	1.514	7.62	3	-0.3	40.3		
7/17/2007 11:45	25.94	9.776	5.49	96.3	7.58	0.446	7.62	3	-0.3	40.3	32.7	
7/17/2007 11:34	25.32	10.48	5.92	76.4	6.07	4.444	7.4	4	-0.6	41.1	54.5	A18-Artesian-04
7/17/2007 11:34	25.32	10.48	5.92	76.3	6.06	3.342	7.41	4	-0.6	41.1		
7/17/2007 11:35	25.37	10.48	5.92	76.5	6.07	2.418	7.42	4	-0.6	41.1		
7/17/2007 11:35	25.54	10.49	5.92	77.7	6.15	1.334	7.43	4	-0.6	41.1		
7/17/2007 11:36	25.67	10.49	5.92	78.4	6.19	0.532	7.44	4	-0.6	41.1	49.2	

AUGUST - Pond A18 Discrete Receiving Water Quality Monitoring

Low tide: 9:43am - flooding. Pond A18 discharging.

DateTime M/D/Y	Temp C	SpCond mS/cm	Salinity ppt	DO % %	DO Conc mg/L	Depth ft	pH	Site	Tidal Height MLLW (ft)	A18 discharge flow cfs	Turbidity NTU	Station
8/15/2007 11:59	24.41	30077	18.63	96.1	7.22	4.297	7.41	1	1.7	66.0	4.0	
8/15/2007 11:59	24.78	25502	15.54	95.7	7.27	3.136	7.71	1	1.7	66.0		
8/15/2007 12:00	25.72	16137	9.43	96	7.42	2.175	7.89	1	1.7	66.0		A18-Artesian-01
8/15/2007 12:01	26.42	3212	1.67	95.8	7.64	1.096	8.35	1	1.7	66.0		
8/15/2007 12:01	26.51	1418	0.71	95.8	7.67	0.375	8.31	1	1.7	66.0	3.0	
8/15/2007 11:42	25.21	20174	12.03	85.6	6.58	4.252	7.42	2	1.3	68.0	16.6	
8/15/2007 11:42	25.35	16926	9.93	87.2	6.77	3.294	7.55	2	1.3	68.0		
8/15/2007 11:42	25.69	12606	7.22	91.8	7.19	2.339	7.63	2	1.3	68.0		A18-Artesian-02
8/15/2007 11:43	26.14	8532	4.74	94.2	7.42	1.352	7.72	2	1.3	68.0		
8/15/2007 11:43	26.2	7497	4.12	95.5	7.55	0.324	7.64	2	1.3	68.0	2.5	
8/15/2007 11:31	26.19	6042	3.27	79.2	6.29	4.917	7.45	3	0.9	70.0	38.3	
8/15/2007 11:31	26.24	6024	3.26	79.6	6.32	3.125	7.42	3	0.9	70.0		
8/15/2007 11:32	26.29	6029	3.27	82.2	6.52	2.067	7.39	3	0.9	70.0		A18-Artesian-03
8/15/2007 11:32	26.44	6025	3.26	82.9	6.55	1.045	7.37	3	0.9	70.0		
8/15/2007 11:32	26.49	6010	3.25	84.1	6.64	0.108	7.37	3	0.9	70.0	19.3	
8/15/2007 11:17	23.3	22280	13.43	50.3	3.97	3.271	6.97	4	0.5	71.9	118.0	
8/15/2007 11:18	23.28	22222	13.39	48.5	3.83	2.452	7.08	4	0.5	71.9		A18-Artesian-04
8/15/2007 11:18	23.23	21927	13.2	48.8	3.86	1.415	7.17	4	0.5	71.9		
8/15/2007 11:19	24.32	15608	9.11	51.5	4.09	0.243	7.32	4	0.5	71.9	27.3	

SEPTEMBER - Pond A18 Discrete Receiving Water Quality Monitoring
Low tide: 12:20pm - ebbing. Pond A18 discharging.

DateTime M/D/Y	Temp C	SpCond mS/cm	Salinity ppt	DO % %	DO Conc mg/L	Depth ft	pH	Site	Tidal Height MLLW (ft)	A18 discharge flow cfs	Turbidity NTU	Station
9/26/2007 10:45	22.49	31.94	19.94	77.6	5.99	5.817	8.32	1	4.3	44.2	12.4	A18-Artesian-01
9/26/2007 10:46	22.51	31.63	19.72	77.3	5.97	4.797	8.32	1	4.3	44.2		
9/26/2007 10:47	23.15	25.54	15.59	81.1	6.34	3.867	8.21	1	4.3	44.2		
9/26/2007 10:48	24.96	10.03	5.64	86.9	6.96	2.846	7.53	1	4.3	44.2		
9/26/2007 10:49	25.87	1.371	0.68	88.4	7.16	1.74	7.76	1	4.3	44.2		
9/26/2007 10:49	25.95	1.299	0.65	90.5	7.32	0.804	7.41	1	4.3	44.2	2.3	
9/26/2007 10:35	23.04	23.83	14.45	85.1	6.71	6.411	8.1	2	3.7	47.6	13.9	A18-Artesian-02
9/26/2007 10:35	23.97	14.68	8.53	83.6	6.71	5.351	8.08	2	3.7	47.6		
9/26/2007 10:36	24.37	9.594	5.39	81.6	6.61	4.317	7.79	2	3.7	47.6		
9/26/2007 10:36	24.73	7.618	4.2	83.7	6.78	3.35	7.72	2	3.7	47.6		
9/26/2007 10:37	25.36	5.147	2.76	91	7.35	2.317	7.63	2	3.7	47.6		
9/26/2007 10:37	25.46	4.272	2.27	91.7	7.42	1.206	7.51	2	3.7	47.6		
9/26/2007 10:38	25.51	3.882	2.05	91.8	7.43	0.268	7.47	2	4.3	44.2	5.6	
9/26/2007 10:19	24	9.13	5.11	60.2	4.92	7.186	7.45	3	3.1	50.8	59.5	A18-Artesian-03
9/26/2007 10:20	24	9.135	5.11	60.1	4.91	6.104	7.43	3	3.1	50.8		
9/26/2007 10:21	24	9.14	5.11	60.1	4.92	5.145	7.42	3	3.1	50.8		
9/26/2007 10:22	23.99	9.144	5.12	59.7	4.89	4.131	7.42	3	3.1	50.8		
9/26/2007 10:23	24.01	9.157	5.12	59.4	4.85	3.141	7.41	3	3.7	47.6		
9/26/2007 10:23	24	9.161	5.13	59.6	4.87	2.119	7.41	3	3.7	47.6		
9/26/2007 10:26	24.14	9.177	5.14	59.2	4.83	0.997	7.41	3	3.7	47.6		
9/26/2007 10:27	24.15	9.172	5.13	60	4.89	0.214	7.41	3	3.7	47.6	41.5	
9/26/2007 10:07	20.83	21.51	12.95	31.6	2.62	5.514	7.55	4	3.1	50.8	82.5	A18-Artesian-04
9/26/2007 10:07	20.85	21.46	12.91	31.7	2.62	4.394	7.56	4	3.1	50.8		
9/26/2007 10:08	20.86	21.46	12.91	31.5	2.61	3.41	7.56	4	3.1	50.8		
9/26/2007 10:08	20.92	21.26	12.78	31.3	2.6	2.721	7.56	4	3.1	50.8		
9/26/2007 10:08	20.93	21.11	12.68	31.3	2.6	1.565	7.56	4	3.1	50.8		
9/26/2007 10:08	20.96	21.01	12.61	31.5	2.61	0.341	7.56	4	3.1	50.8	42.0	

OCTOBER - Pond A18 Discrete Receiving Water Quality Monitoring

Low tide: 11:03am - flooding. Pond A18 not discharging. Discharge began at 1530.

DateTime M/D/Y	Temp C	SpCond mS/cm	Salinity ppt	DO % %	DO Conc mg/L	Depth ft	pH	Site	Tidal Height MLLW (ft)	A18 discharge flow cfs	Turbidity NTU	Station
10/16/2007 14:43	19.94	28.54	17.64	43.9	3.6	8.294	8.14	1	7.3	0.0	8.5	A18-Artesian-01
10/16/2007 14:43	20.52	23.38	14.18	43.2	3.57	7.164	8.14	1	7.3	0.0		
10/16/2007 14:44	20.74	21.91	13.21	46.5	3.86	5.888	7.97	1	7.3	0.0		
10/16/2007 14:43	21.01	20.43	12.23	46.6	3.87	5.597	8.02	1	7.3	0.0		
10/16/2007 14:44	20.98	18.81	11.19	47.9	4	4.804	7.99	1	7.3	0.0		
10/16/2007 14:44	21.86	13.15	7.58	53.6	4.5	3.616	7.95	1	7.3	0.0		
10/16/2007 14:44	22.8	9.362	5.25	63.1	5.27	3.175	7.85	1	7.3	0.0		
10/16/2007 14:45	23.81	4.009	2.12	73	6.1	2.081	7.8	1	7.3	0.0		
10/16/2007 14:45	24.02	2.875	1.49	80	6.67	1.1	7.62	1	7.3	0.0		
10/16/2007 14:46	24.23	2.437	1.25	82.7	6.88	0.074	7.54	1	7.3	0.0	2.0	
10/16/2007 14:33	19.71	27.81	17.15	60.1	4.97	8.645	7.88	2	6.9	0.0	11.2	A18-Artesian-02
10/16/2007 14:34	19.99	26.51	16.27	53	4.38	7.526	8.18	2	6.9	0.0		
10/16/2007 14:34	20.41	24.35	14.83	50.5	4.17	6.583	8.16	2	6.9	0.0		
10/16/2007 14:35	20.75	20.95	12.58	45.8	3.82	5.594	8.1	2	6.9	0.0		
10/16/2007 14:36	20.77	16.66	9.8	39.2	3.31	4.664	7.74	2	6.9	0.0		
10/16/2007 14:36	22.24	9.014	5.05	46.2	3.9	3.63	7.77	2	6.9	0.0		
10/16/2007 14:36	22.81	7.22	3.98	56.9	4.78	3.61	7.72	2	6.9	0.0		
10/16/2007 14:36	23.71	4.333	2.3	69.5	5.8	2.576	7.72	2	6.9	0.0		
10/16/2007 14:37	23.92	3.305	1.73	79.7	6.65	1.543	7.58	2	6.9	0.0		
10/16/2007 14:37	23.88	3.194	1.67	81.8	6.84	0.248	7.47	2	6.9	0.0	2.6	
10/16/2007 14:20	20.6	24.21	14.73	31	2.56	9.733	7.87	3	6.6	0.0	19.4	A18-Artesian-03
10/16/2007 14:20	20.6	23.99	14.58	29.7	2.45	8.704	7.92	3	6.6	0.0		
10/16/2007 14:21	20	22.22	13.42	27.9	2.34	7.774	7.92	3	6.6	0.0		
10/16/2007 14:21	19.23	20.18	12.09	27.8	2.39	6.702	7.78	3	6.6	0.0		
10/16/2007 14:22	19.11	19.07	11.37	28.8	2.49	5.722	7.74	3	6.6	0.0		
10/16/2007 14:22	19.2	18.67	11.1	31.2	2.7	4.8	7.69	3	6.6	0.0		
10/16/2007 14:23	19.22	18.42	10.94	34.8	3.01	4.505	7.63	3	6.9	0.0		
10/16/2007 14:23	19.32	18.15	10.77	34.6	2.99	3.802	7.63	3	6.9	0.0		
10/16/2007 14:24	20.59	13.62	7.88	48.2	4.14	2.835	7.61	3	6.9	0.0		
10/16/2007 14:24	22.27	7.149	3.94	50.5	4.29	1.851	7.68	3	6.9	0.0		
10/16/2007 14:24	22.7	5.159	2.78	58.7	4.98	0.15	7.73	3	6.9	0.0	3.5	
10/16/2007 14:00	17.34	29.46	18.27	53	4.56	10.556	7.76	4	6.3	0.0	26.1	A18-Artesian-04
10/16/2007 14:01	17.35	29.19	18.09	52.8	4.54	9.405	7.78	4	6.3	0.0		
10/16/2007 14:02	17.39	28.48	17.61	52.5	4.53	8.532	7.78	4	6.3	0.0		
10/16/2007 14:03	17.43	27.78	17.14	53.7	4.64	7.467	7.78	4	6.3	0.0		
10/16/2007 14:03	17.44	27.49	16.94	54.2	4.69	6.584	7.78	4	6.3	0.0		
10/16/2007 14:04	17.45	27.24	16.77	55.2	4.78	5.525	7.78	4	6.3	0.0		
10/16/2007 14:05	17.5	26.62	16.35	55.2	4.79	4.666	7.78	4	6.3	0.0		
10/16/2007 14:05	17.52	26.5	16.27	54.9	4.76	3.582	7.78	4	6.3	0.0		
10/16/2007 14:06	17.54	26.25	16.11	54.7	4.75	2.542	7.78	4	6.3	0.0		
10/16/2007 14:07	17.55	26.1	16.01	54.3	4.72	1.662	7.78	4	6.3	0.0		
10/16/2007 14:07	17.58	25.44	15.56	54.3	4.72	0.527	7.78	4	6.3	0.0	26.8	

OCTOBER - Pond A18 Discrete Receiving Water Quality Monitoring

Low tide: 9:25am - flooding. Pond A18 discharging. Discharge began at 10:55am.

DateTime M/D/Y	Temp C	SpCond mS/cm	Salinity ppt	DO % %	DO Conc mg/L	Depth ft	pH	Site	Tidal Height MLLW (ft)	A18 discharge flow cfs	Turbidity NTU	Station
10/29/2007 12:35	21.17	27.86	17.17	100.9	8.11	5.749	8.28	1	7.3	17.9	12.0	A18-Artesian-01
10/29/2007 12:36	22.49	18.42	10.92	99.9	8.13	4.654	8.25	1	7.3	17.9		
10/29/2007 12:36	24.57	2.147	1.1	89.3	7.39	3.771	7.94	1	7.3	17.9		
10/29/2007 12:37	24.75	1.218	0.6	86.7	7.18	2.713	7.73	1	7.5	14.6		
10/29/2007 12:37	24.76	1.215	0.6	86.5	7.16	1.717	7.53	1	7.5	14.6		
10/29/2007 12:38	24.76	1.196	0.59	86.5	7.16	0.668	7.49	1	7.5	14.6	2.7	
10/29/2007 12:27	20.82	30.49	18.96	88.2	7.06	7.811	8.37	2	7.3	17.9	8.3	A18-Artesian-02
10/29/2007 12:27	21.5	23.87	14.5	90.2	7.32	6.785	8.34	2	7.3	17.9		
10/29/2007 12:27	21.81	19.67	11.74	72	5.9	5.723	8.12	2	7.3	17.9		
10/29/2007 12:28	22.72	12.3	7.05	65.2	5.4	4.735	7.83	2	7.3	17.9		
10/29/2007 12:29	23.78	5.968	3.24	80.7	6.7	3.779	7.65	2	7.3	17.9		
10/29/2007 12:29	23.81	5.312	2.86	81.3	6.76	2.659	7.59	2	7.3	17.9		
10/29/2007 12:29	23.88	5.074	2.73	82.5	6.85	1.738	7.53	2	7.3	17.9		
10/29/2007 12:29	23.91	4.921	2.64	83.1	6.9	0.714	7.5	2	7.3	17.9	4.4	
10/29/2007 11:57	21.36	19.98	11.94	34.5	2.84	8.022	7.54	3	6.4	28.3	10.6	A18-Artesian-03
10/29/2007 11:58	21.41	19.58	11.68	35	2.89	7.141	7.58	3	6.4	28.3		
10/29/2007 11:58	21.61	18.05	10.69	36.6	3.03	6.179	7.58	3	6.4	28.3		
10/29/2007 11:59	21.98	14.77	8.6	39.8	3.31	5.131	7.59	3	6.4	28.3		
10/29/2007 12:00	22.59	10.57	5.99	57.2	4.78	4.076	7.49	3	6.4	28.3		
10/29/2007 12:00	22.95	8.818	4.93	65.6	5.47	3.067	7.46	3	6.4	28.3		
10/29/2007 12:01	22.94	8.738	4.88	67.7	5.66	2.016	7.44	3	6.4	28.3		
10/29/2007 12:01	22.92	8.768	4.9	68	5.68	1.036	7.42	3	6.4	28.3	6.8	
10/29/2007 11:41	18.89	24.59	14.99	47.3	4.02	7.508	7.6	4	5.9	32.6	56.0	A18-Artesian-04
10/29/2007 11:41	18.9	24.57	14.98	46.5	3.96	6.714	7.61	4	5.9	32.6		
10/29/2007 11:42	18.93	24.54	14.96	46.5	3.95	5.407	7.62	4	5.9	32.6		
10/29/2007 11:42	19.06	24.22	14.75	46.8	3.97	4.497	7.63	4	5.9	32.6		
10/29/2007 11:43	19.11	24.04	14.62	48.2	4.09	3.521	7.64	4	5.9	32.6		
10/29/2007 11:43	19.15	23.98	14.59	48.7	4.13	2.518	7.64	4	5.9	32.6		
10/29/2007 11:44	19.27	23.66	14.37	50.1	4.24	1.475	7.65	4	5.9	32.6		
10/29/2007 11:44	19.36	23.35	14.17	50.7	4.3	0.572	7.65	4	5.9	32.6	30.3	

Appendix 3. Comparative Profiles of pH, Salinity and Temperature in A18 and Artesian Slough for Each Month of 2007 Monitoring Season.

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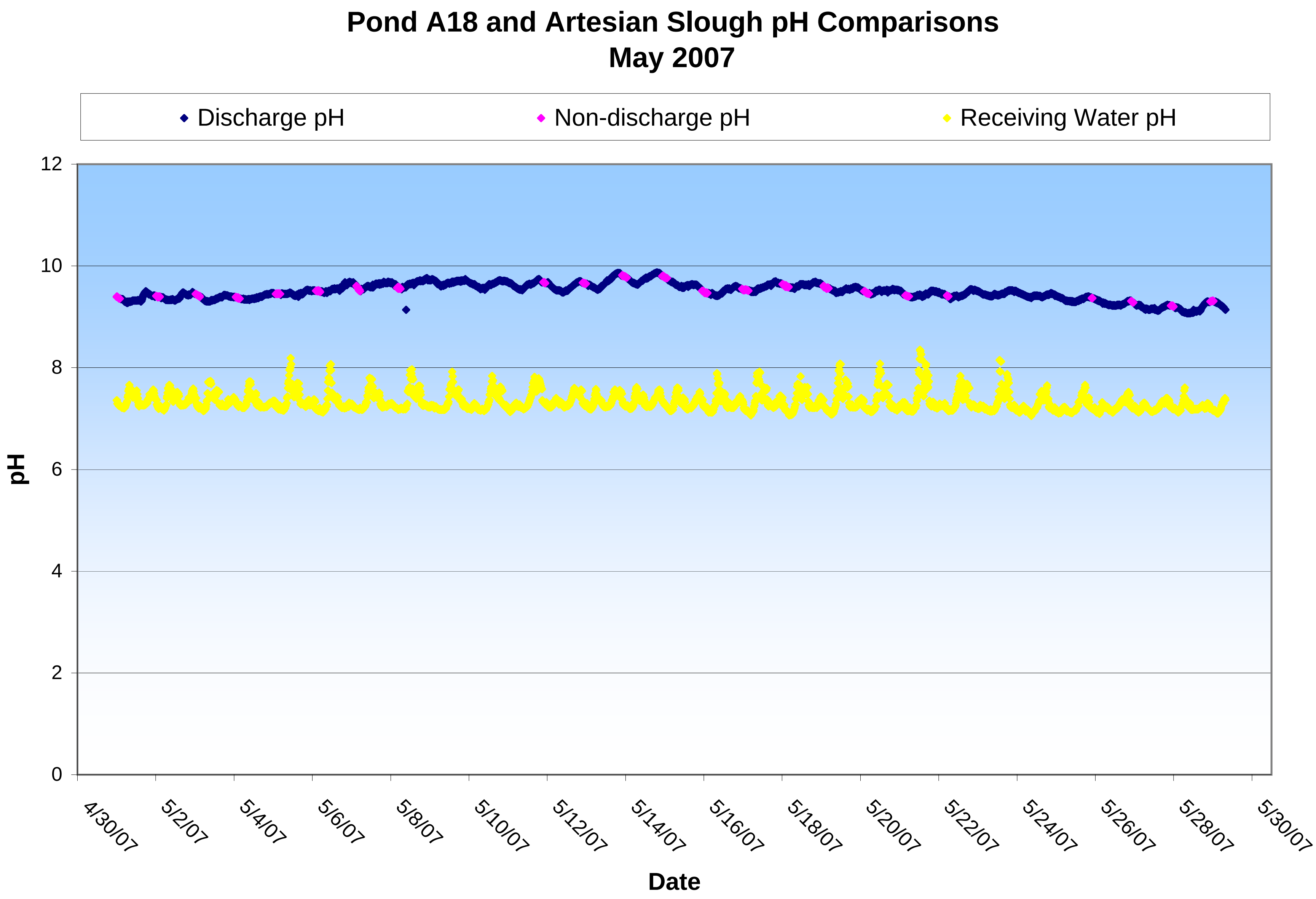
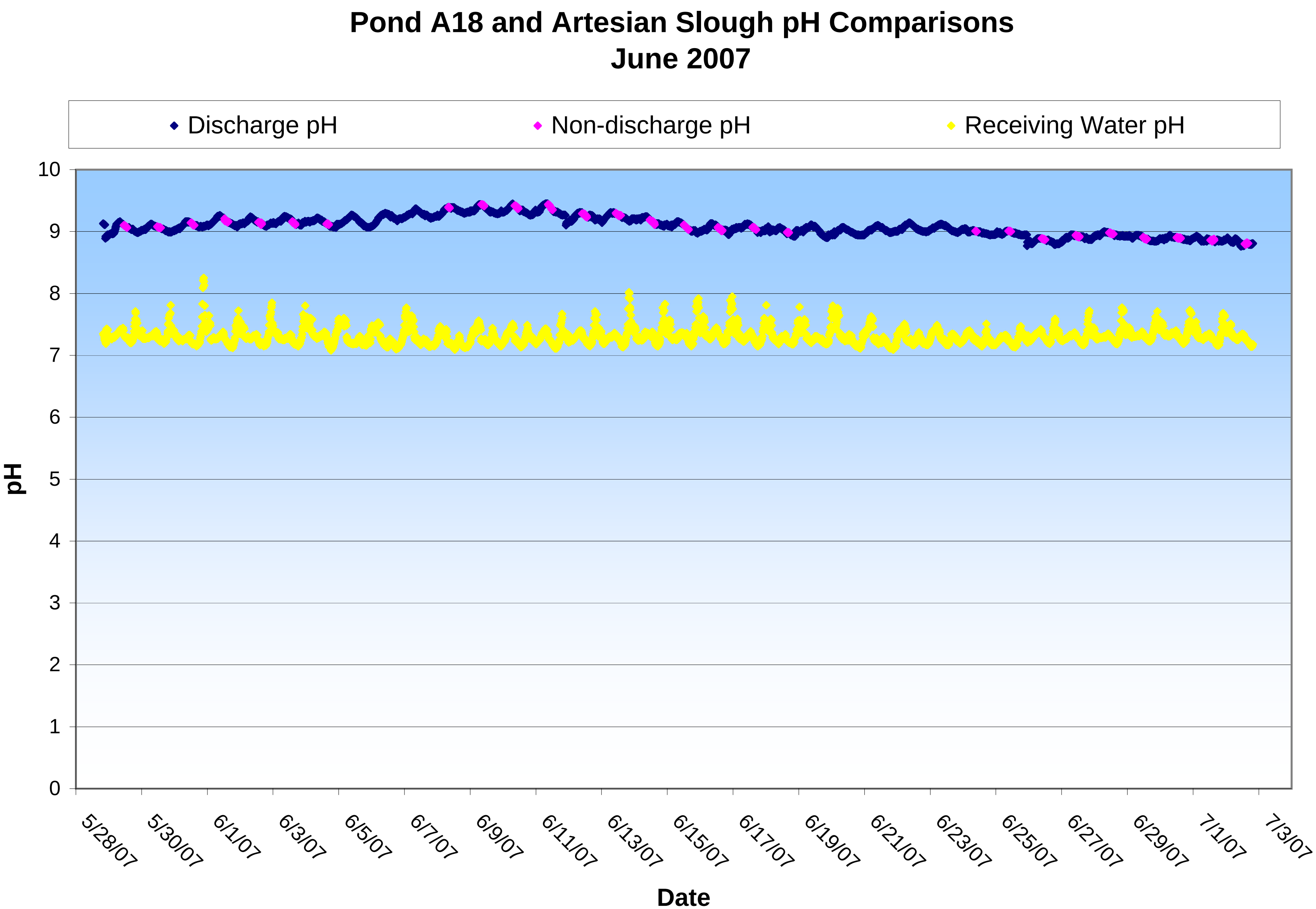
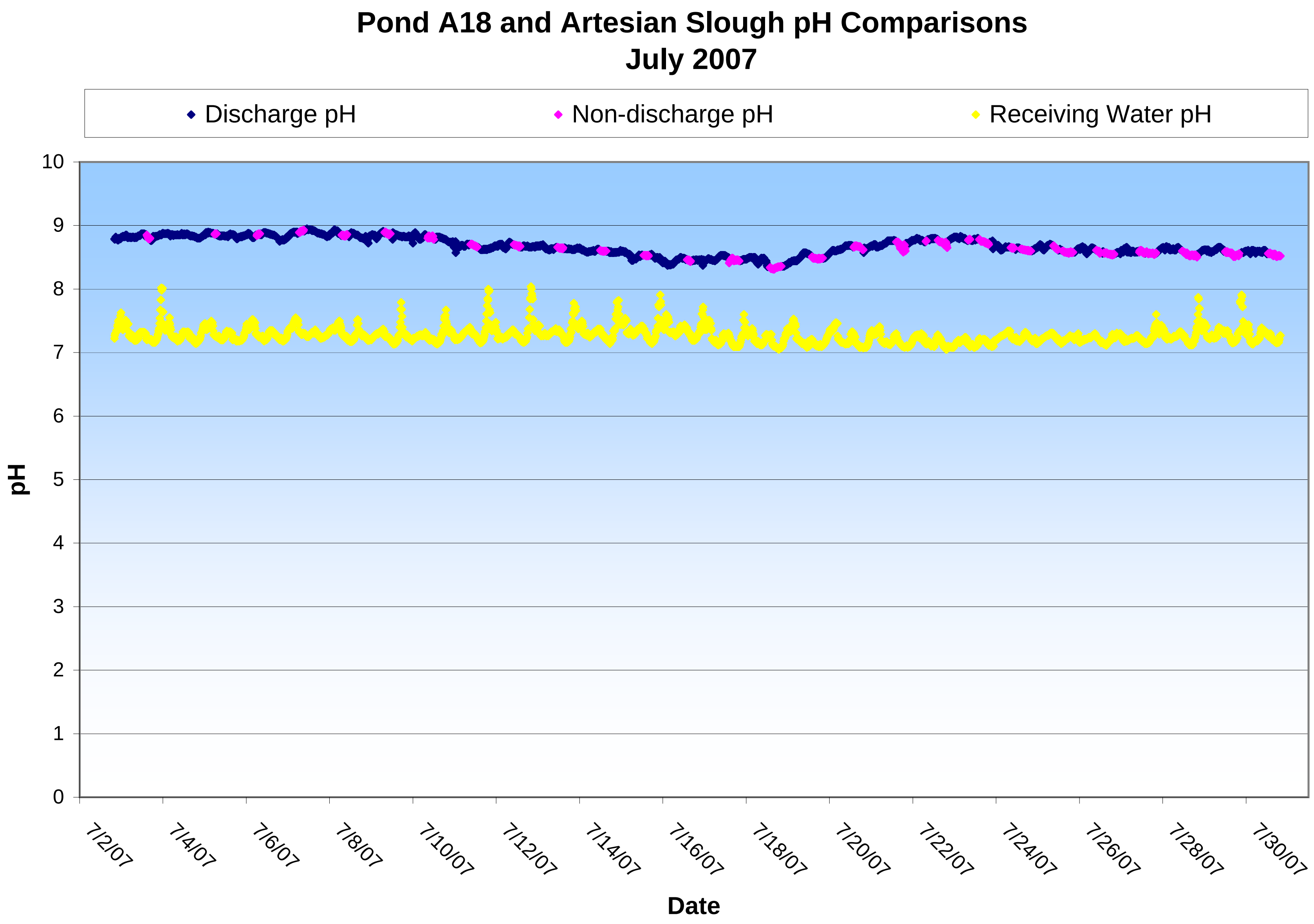
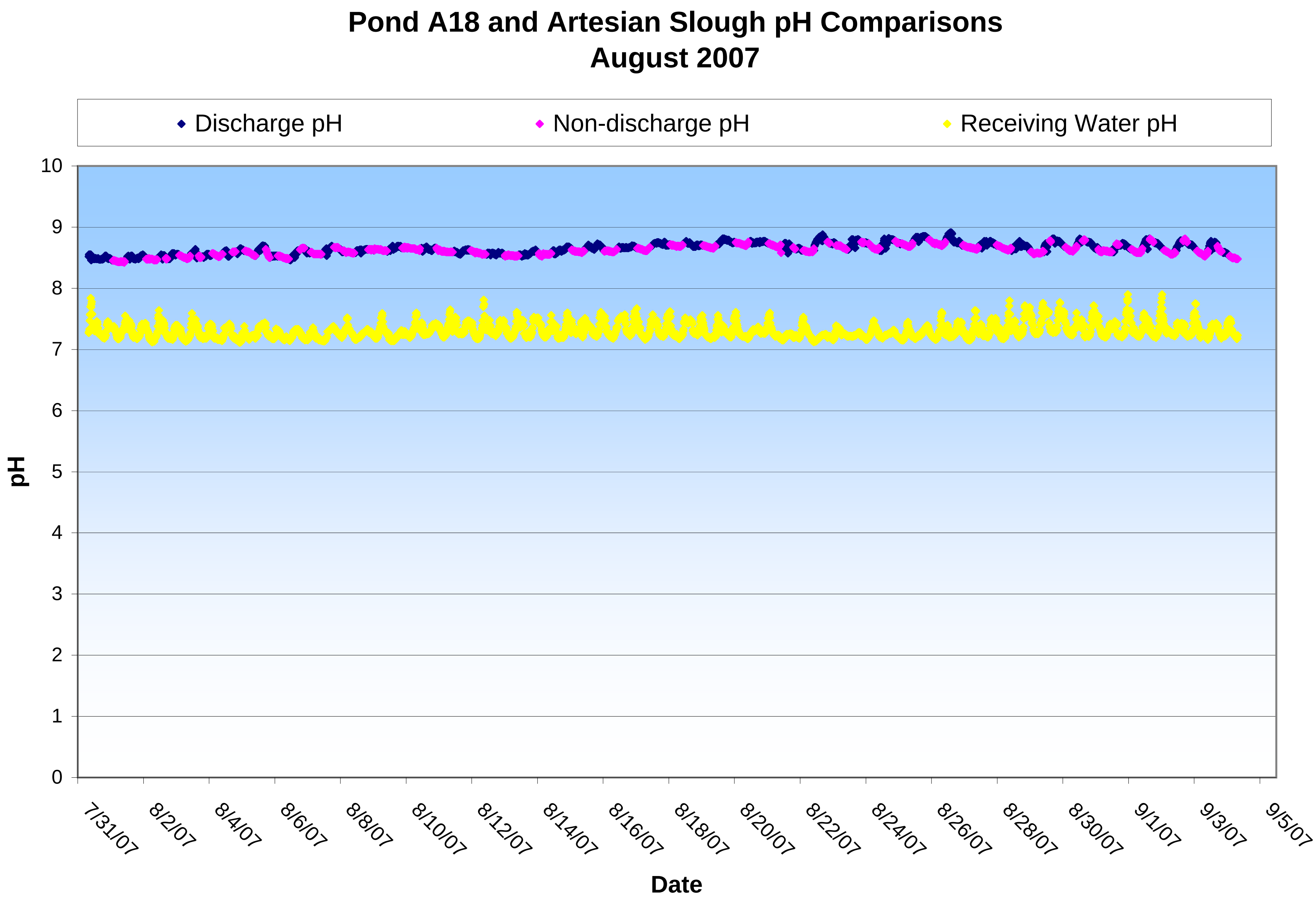
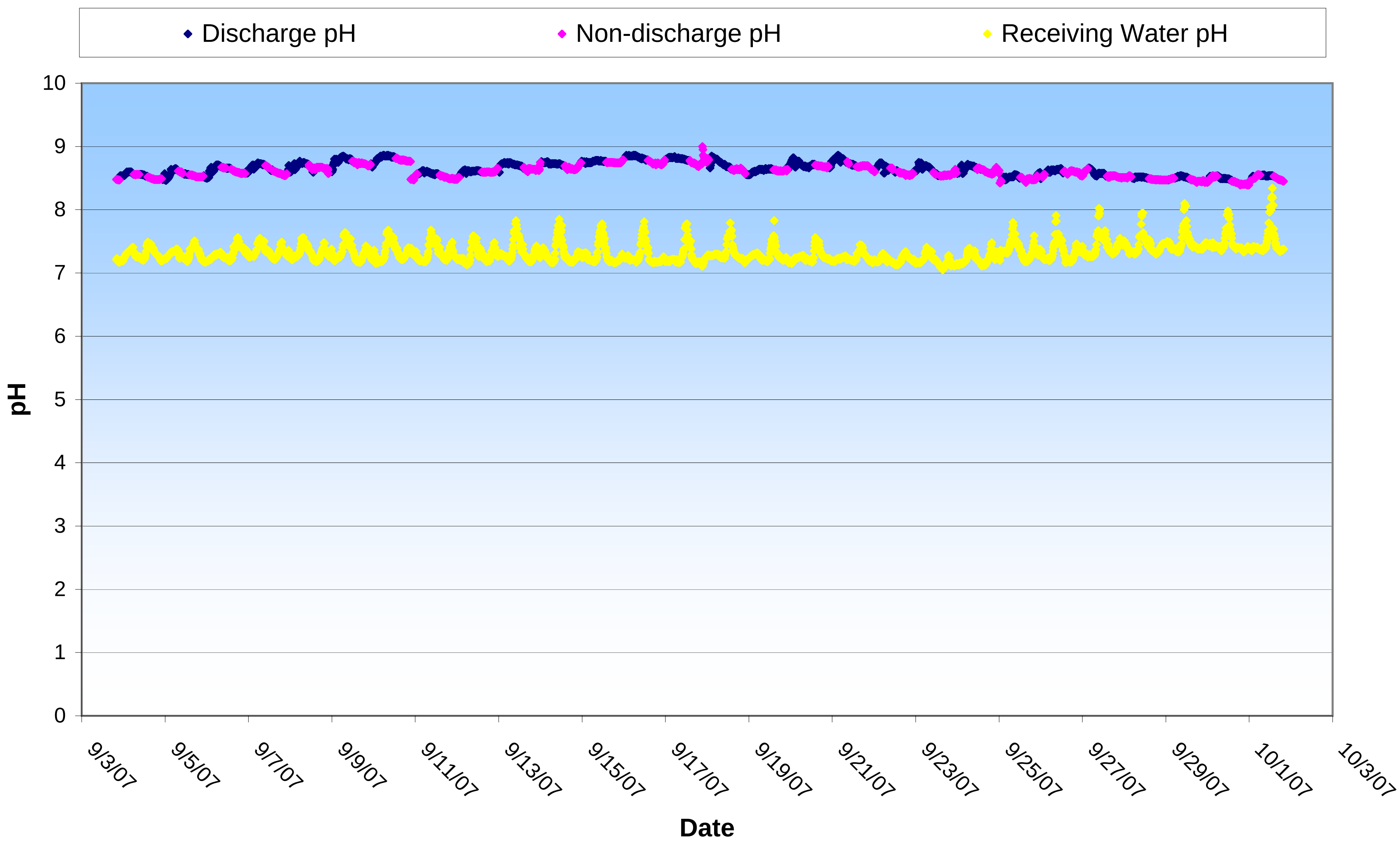

Pond A18 and Artesian Slough pH Comparisons
May 2007
Discharge pH
Non-discharge pH
Receiving Water pH
pH
12
10
8
6
4
2
0
4/30/07
5/2/07
5/4/07
5/6/07
5/8/07
5/10/07
5/12/07
5/14/07
5/16/07
5/18/07
5/20/07
5/22/07
5/24/07
5/26/07
5/28/07
5/30/07
Date

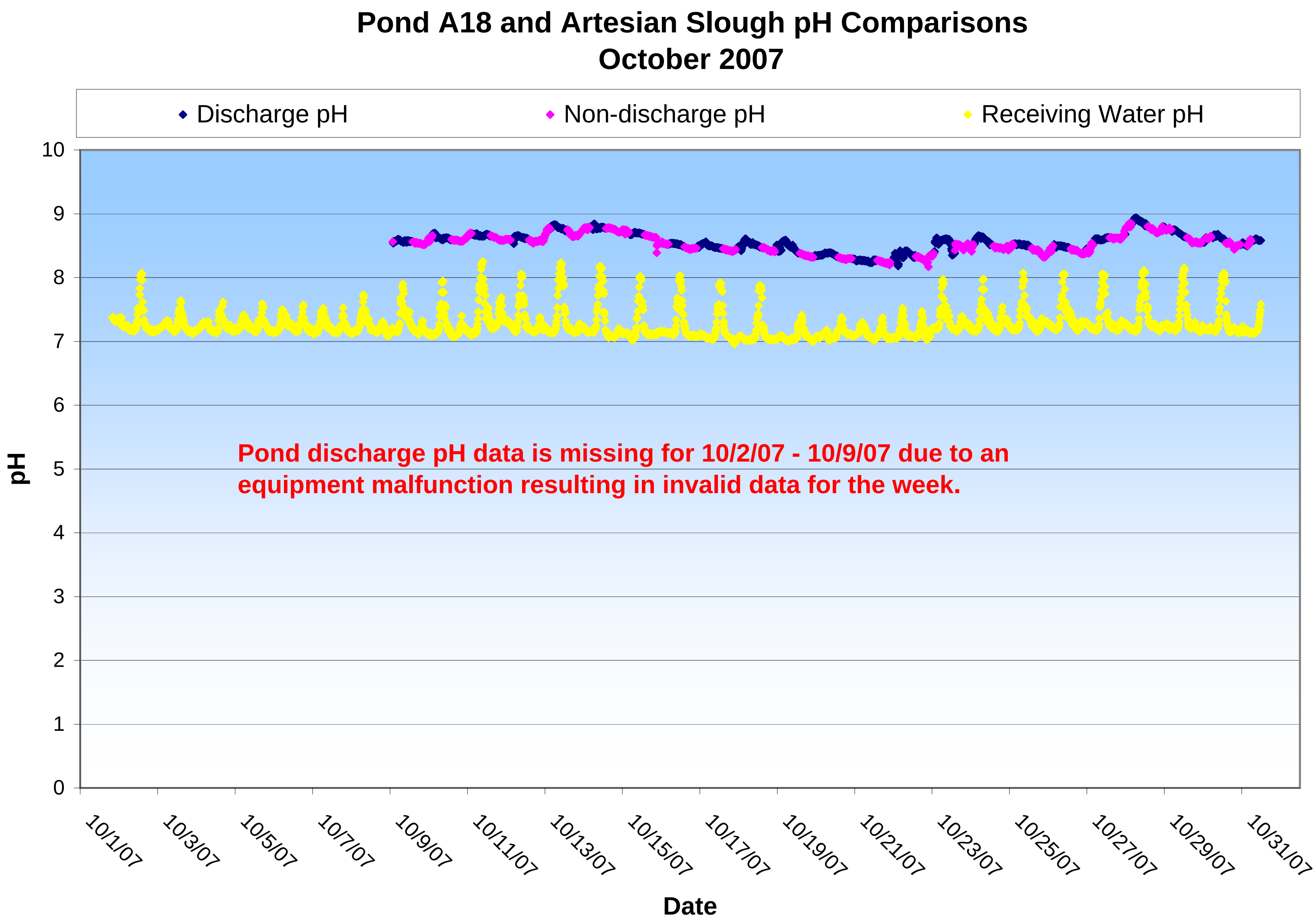

Pond A18 and Artesian Slough pH Comparisons
June 2007
Discharge pH
Non-discharge pH
Receiving Water pH
pH
0
1
2
3
4
5
6
7
8
9
10
5/28/07
5/30/07
6/1/07
6/3/07
6/5/07
6/7/07
6/9/07
6/11/07
6/13/07
6/15/07
6/17/07
6/19/07
6/21/07
6/23/07
6/25/07
6/27/07
6/29/07
7/1/07
7/3/07
Date


Pond A18 and Artesian Slough pH Comparisons
July 2007
Discharge pH
Non-discharge pH
Receiving Water pH
pH
10
9
8
7
6
5
4
3
2
1
0
7/2/07
7/4/07
7/6/07
7/8/07
7/10/07
7/12/07
7/14/07
7/16/07
7/18/07
7/20/07
7/22/07
7/24/07
7/26/07
7/28/07
7/30/07
Date

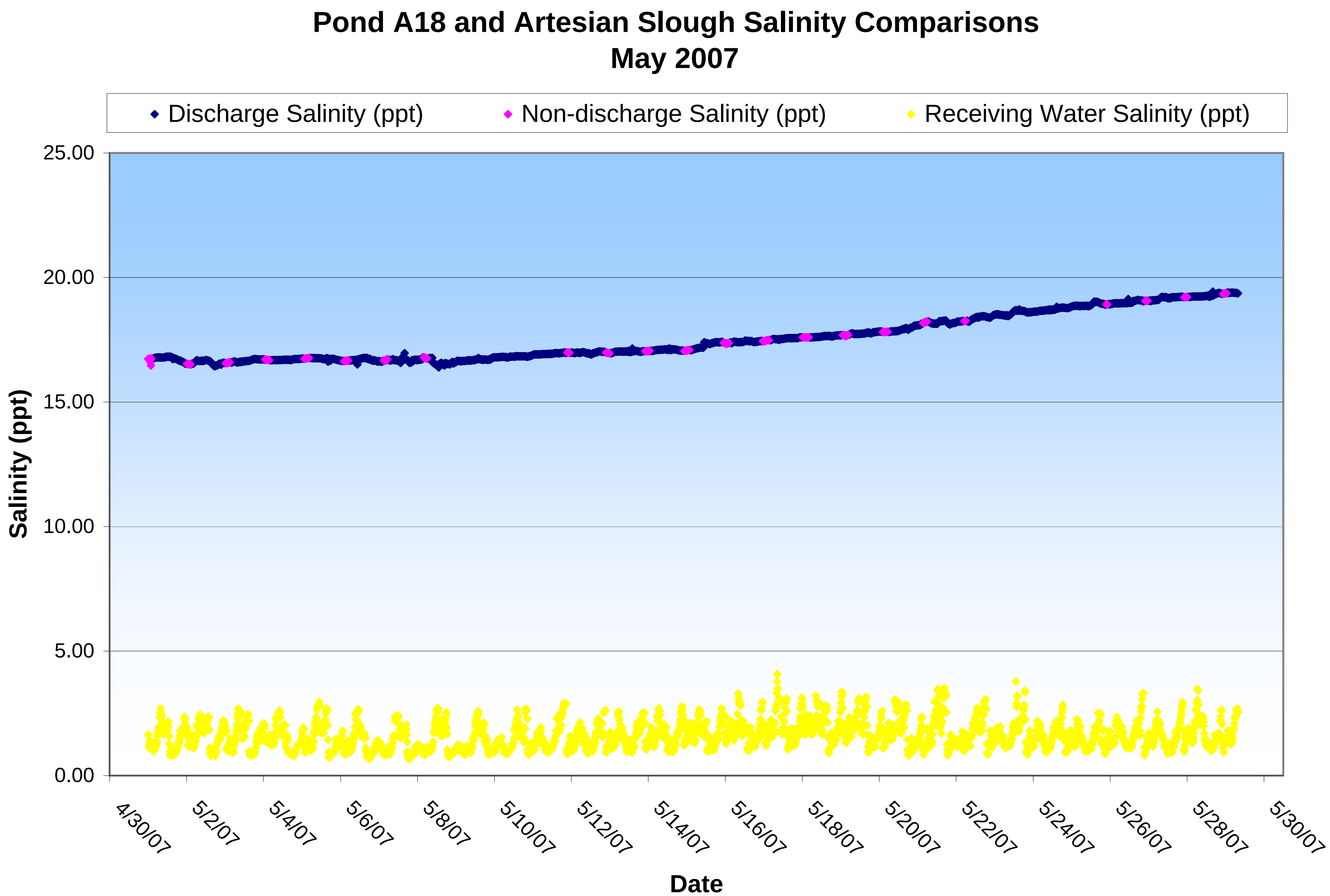

Pond A18 and Artesian Slough pH Comparisons
August 2007
Discharge pH
Non-discharge pH
Receiving Water pH
pH
Date
10
9
8
7
6
5
4
3
2
1
0
7/31/07
8/2/07
8/4/07
8/6/07
8/8/07
8/10/07
8/12/07
8/14/07
8/16/07
8/18/07
8/20/07
8/22/07
8/24/07
8/26/07
8/28/07
8/30/07
9/1/07
9/3/07
9/5/07

Pond A18 and Artesian Slough pH Comparisons
September 2007

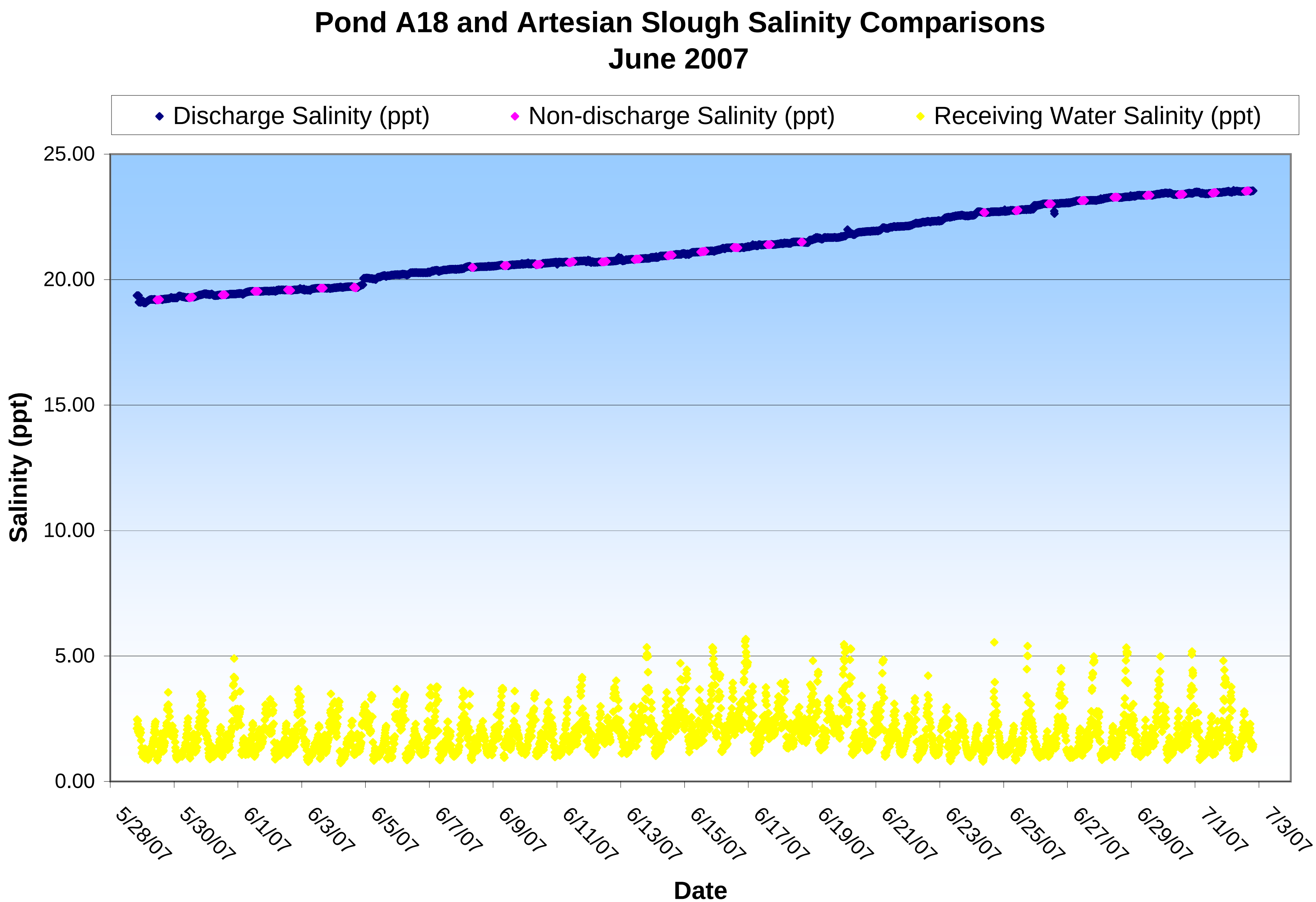




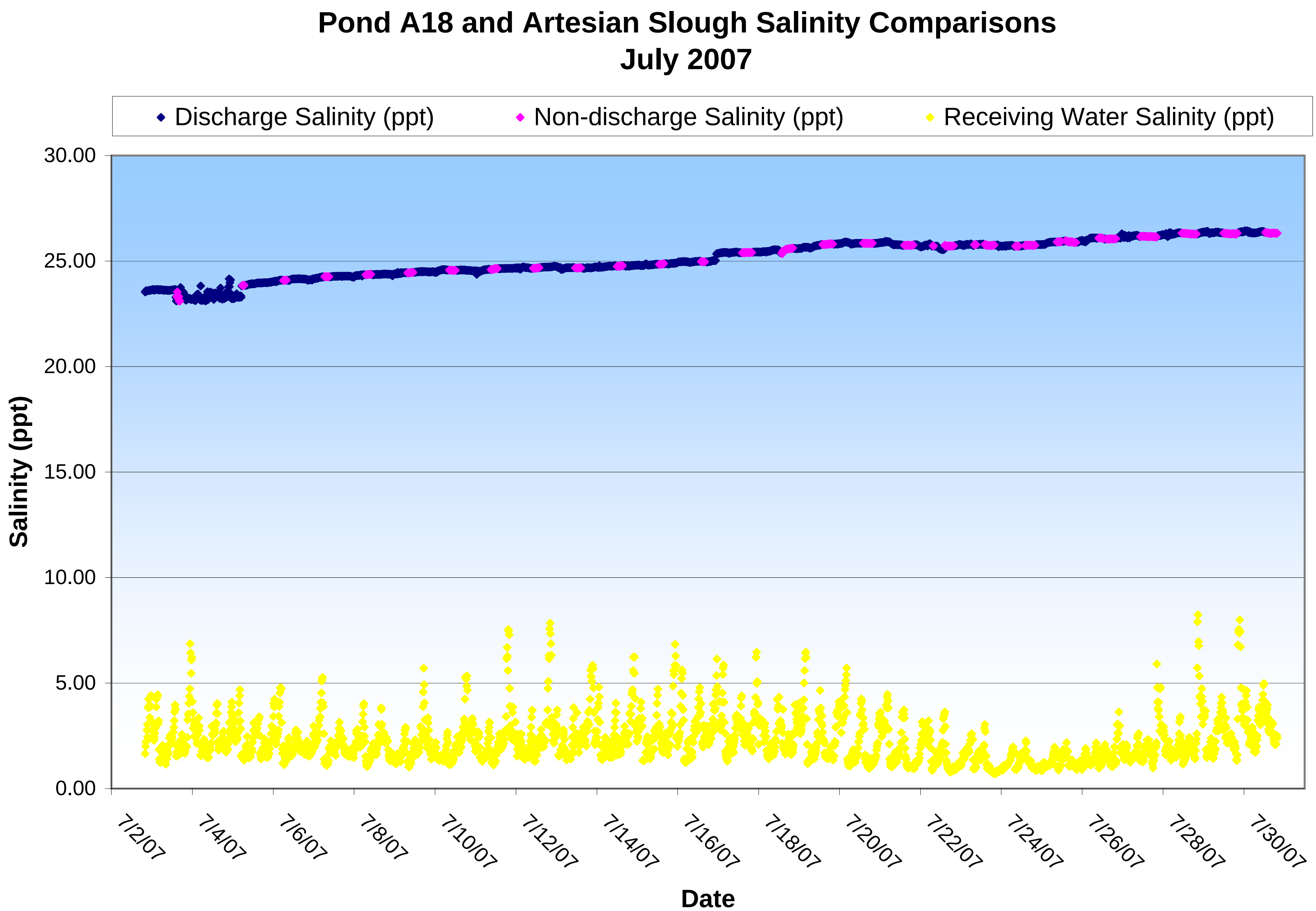
Pond A18 and Artesian Slough pH Comparisons
October 2007
Discharge pH
Non-discharge pH
Receiving Water pH
10
9
8
7
6
5
4
3
2
1
0
pH
Pond discharge pH data is missing for 10/2/07 - 10/9/07 due to an equipment malfunction resulting in invalid data for the week.
10/1/07
10/3/07
10/5/07
10/7/07
10/9/07
10/11/07
10/13/07
10/15/07
10/17/07
10/19/07
10/21/07
10/23/07
10/25/07
10/27/07
10/29/07
10/31/07
Date

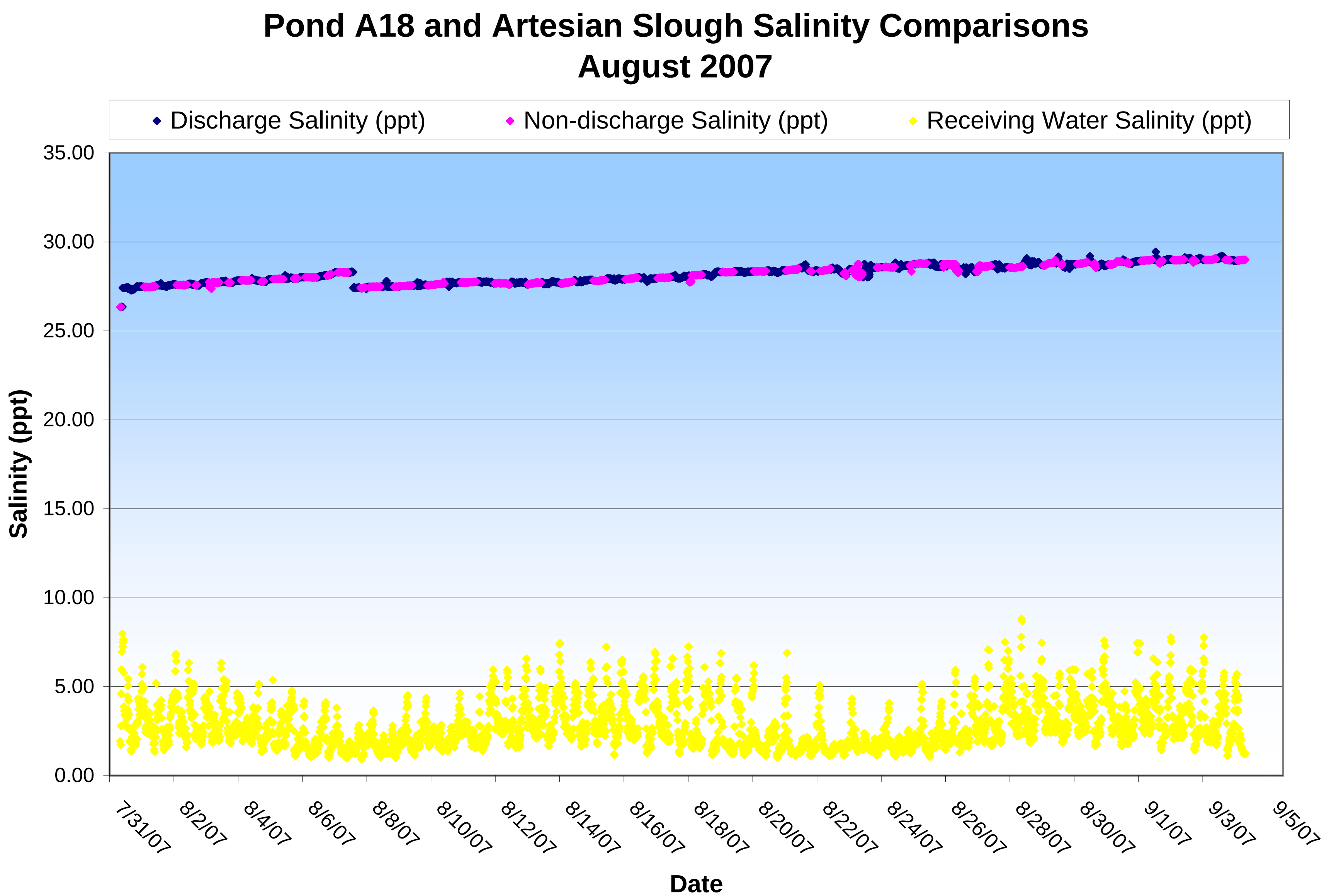


Pond A18 and Artesian Slough Salinity Comparisons
May 2007
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
25.00
20.00
15.00
10.00
5.00
0.00
4/30/07
5/2/07
5/4/07
5/6/07
5/8/07
5/10/07
5/12/07
5/14/07
5/16/07
5/18/07
5/20/07
5/22/07
5/24/07
5/26/07
5/28/07
5/30/07
Date



Pond A18 and Artesian Slough Salinity Comparisons
June 2007
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
25.00
20.00
15.00
10.00
5.00
0.00
5/28/07
5/30/07
6/1/07
6/3/07
6/5/07
6/7/07
6/9/07
6/11/07
6/13/07
6/15/07
6/17/07
6/19/07
6/21/07
6/23/07
6/25/07
6/27/07
6/29/07
7/1/07
7/3/07
Date


Pond A18 and Artesian Slough Salinity Comparisons
July 2007
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
7/2/07
7/4/07
7/6/07
7/8/07
7/10/07
7/12/07
7/14/07
7/16/07
7/18/07
7/20/07
7/22/07
7/24/07
7/26/07
7/28/07
7/30/07
Date



Pond A18 and Artesian Slough Salinity Comparisons
August 2007
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Salinity (ppt)
7/31/07
8/2/07
8/4/07
8/6/07
8/8/07
8/10/07
8/12/07
8/14/07
8/16/07
8/18/07
8/20/07
8/22/07
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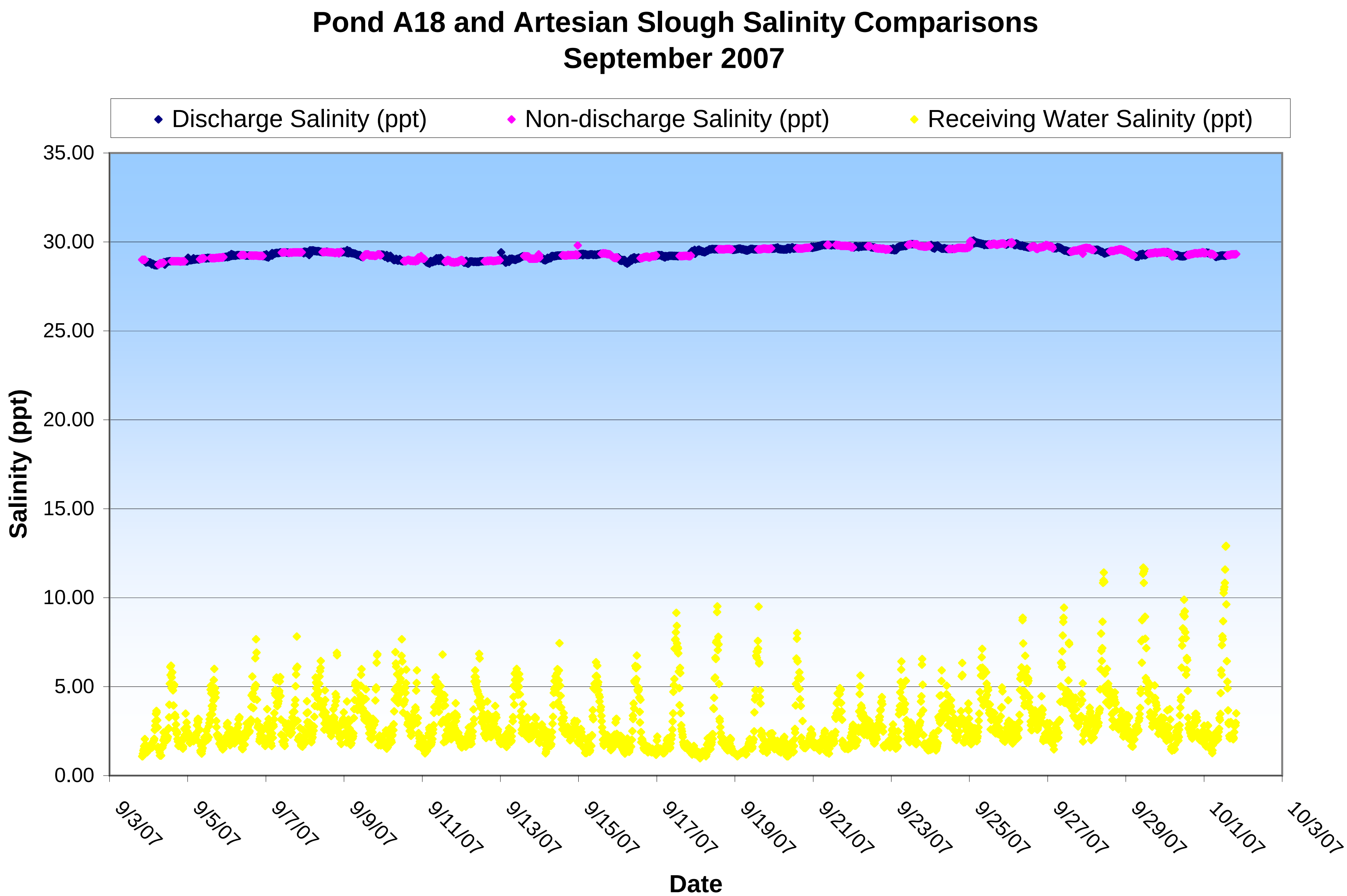
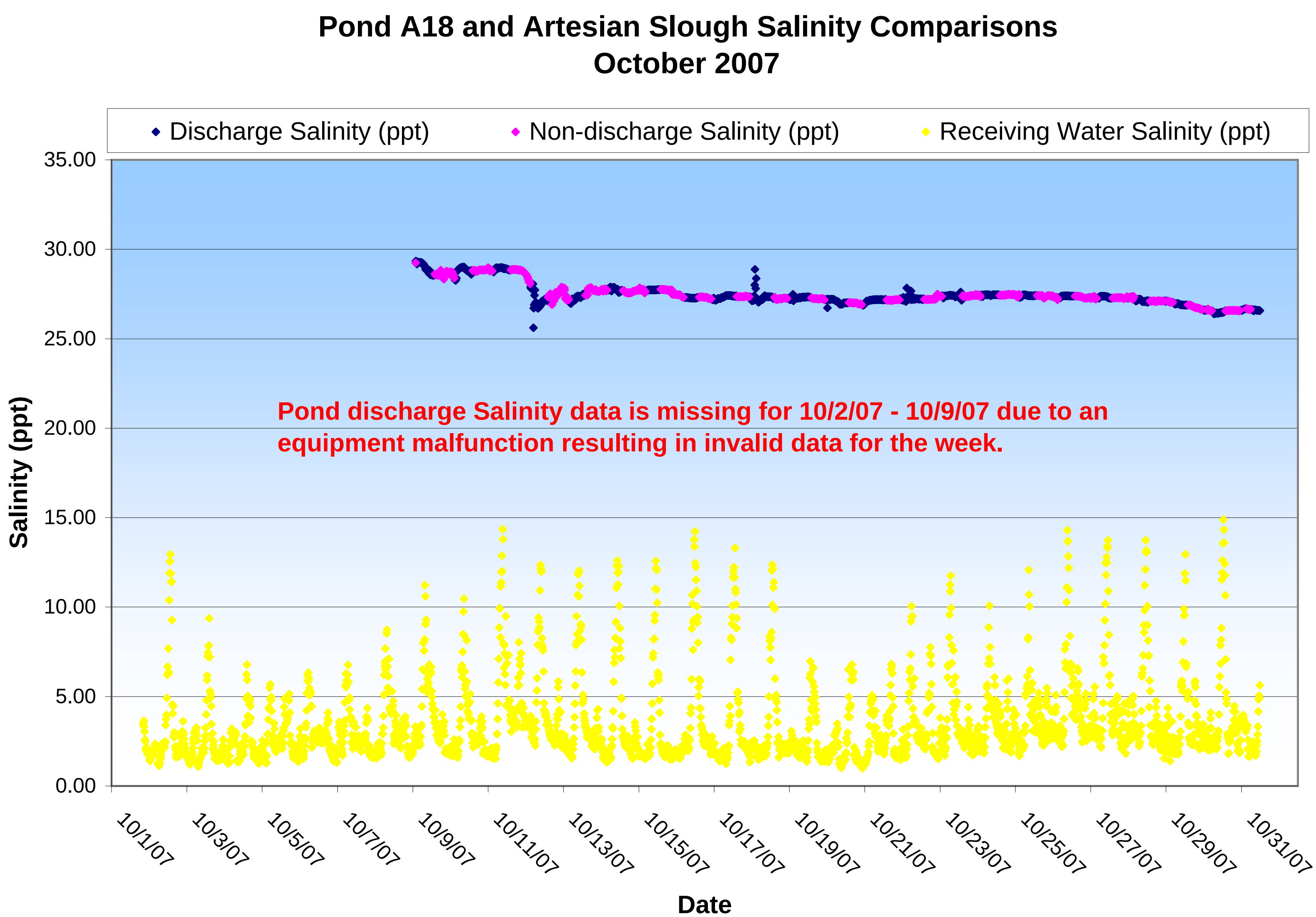
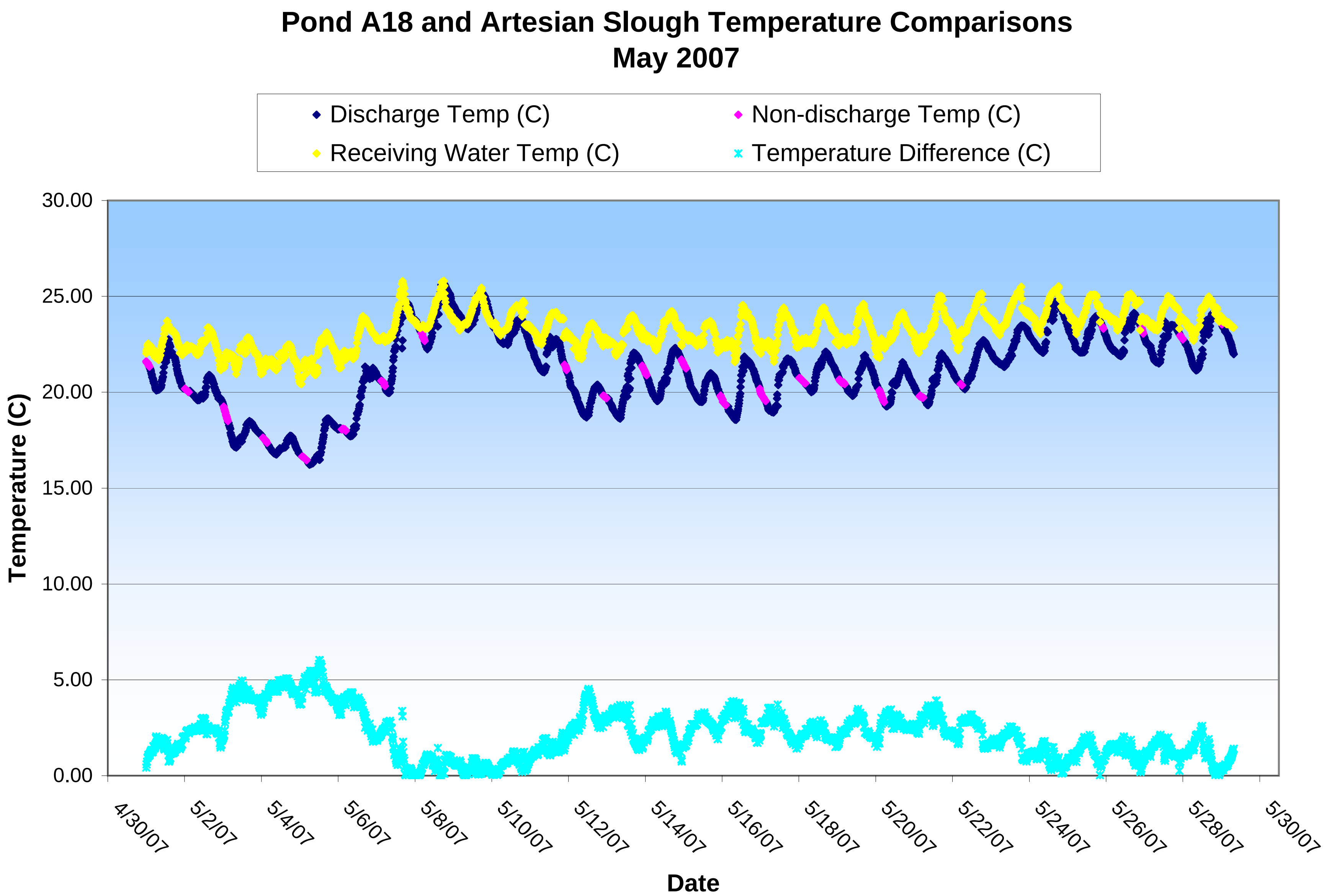
8/26/07
8/28/07
8/30/07
9/1/07
9/3/07
9/5/07
Date

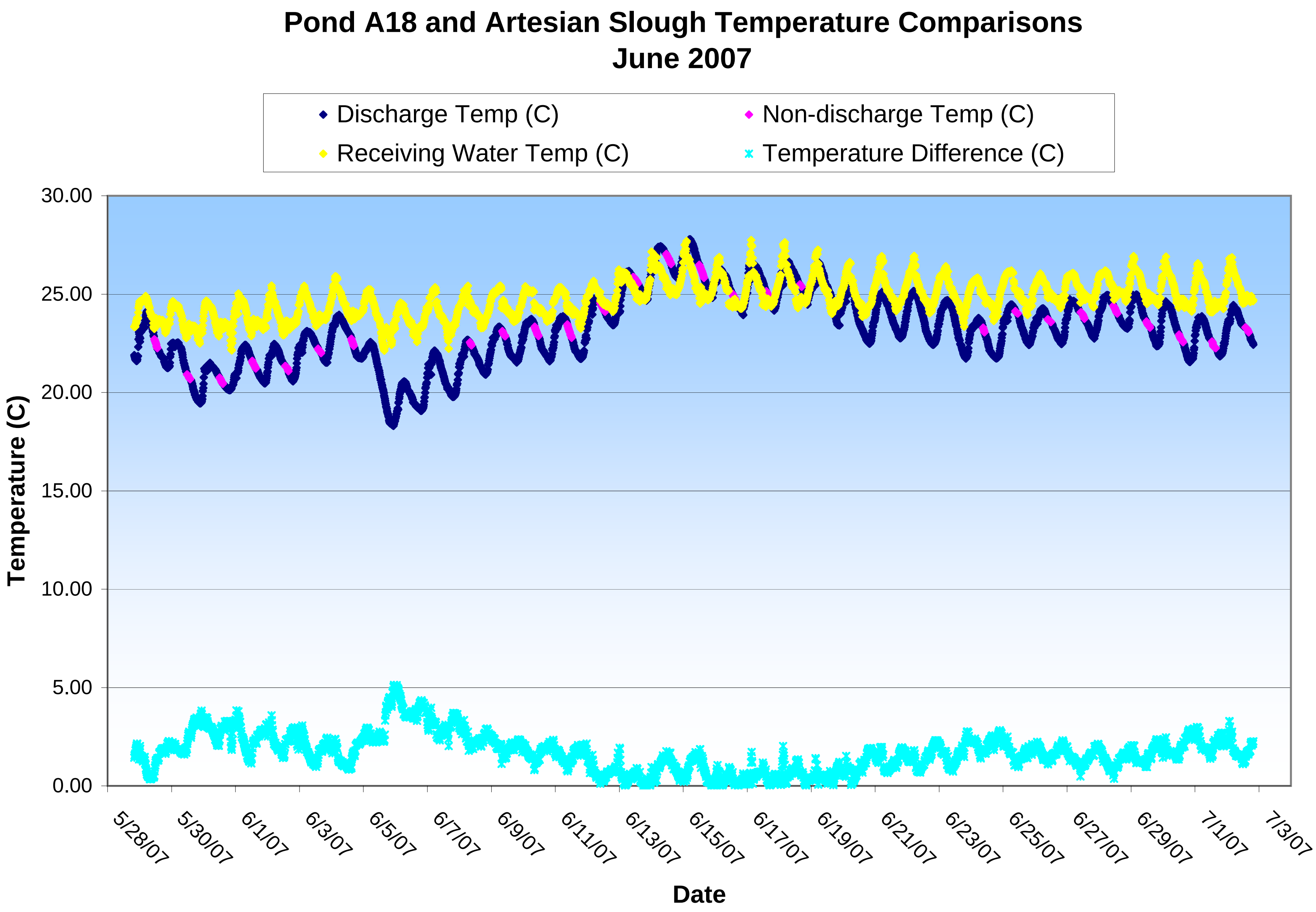


Pond A18 and Artesian Slough Salinity Comparisons
September 2007
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
9/3/07
9/5/07
9/7/07
9/9/07
9/11/07
9/13/07
9/15/07
9/17/07
9/19/07
9/21/07
9/23/07
9/25/07
9/27/07
9/29/07
10/1/07
10/3/07
Date

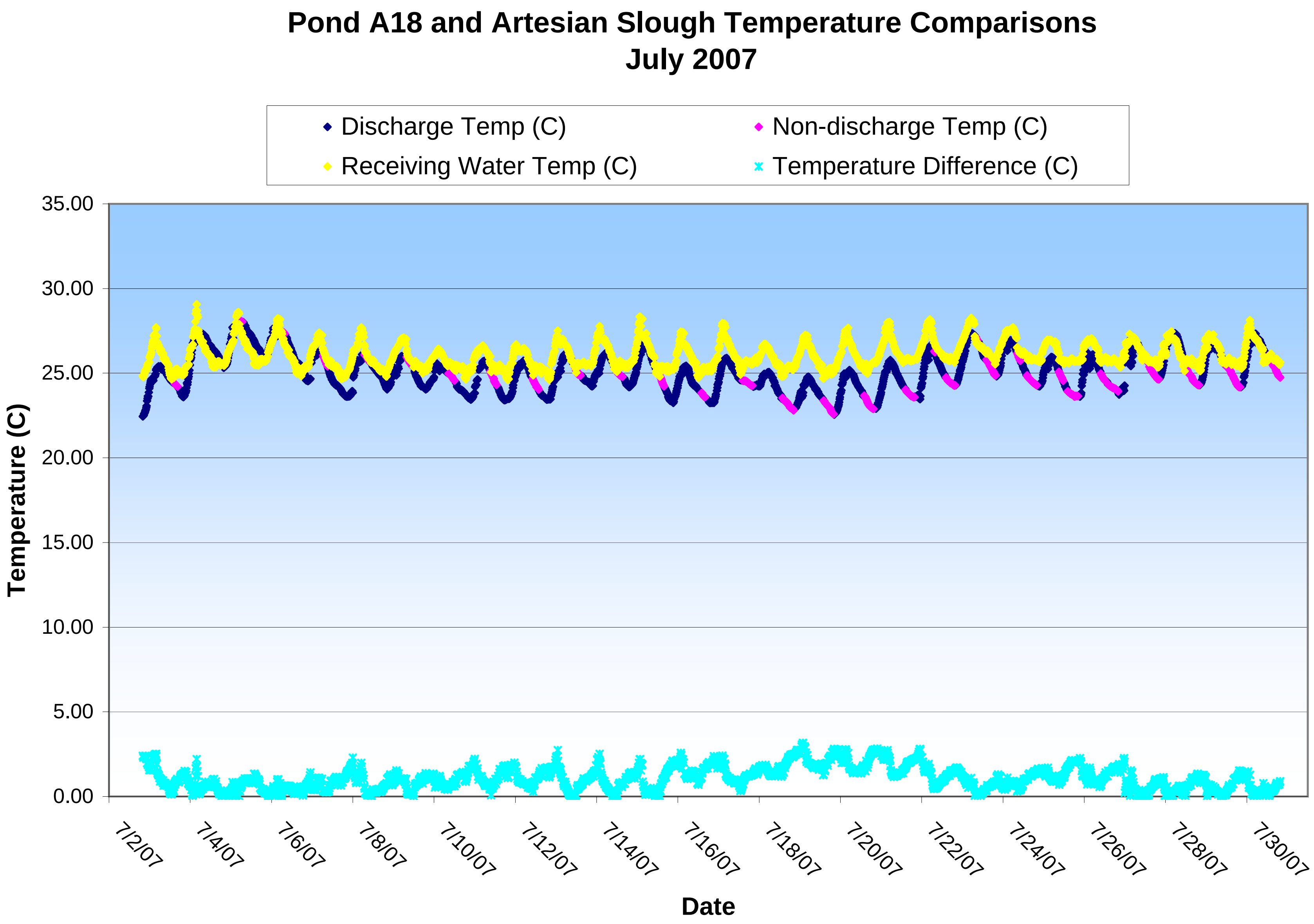


Pond A18 and Artesian Slough Salinity Comparisons
October 2007
Discharge Salinity (ppt)
Non-discharge Salinity (ppt)
Receiving Water Salinity (ppt)
Salinity (ppt)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Pond discharge Salinity data is missing for 10/2/07 - 10/9/07 due to an equipment malfunction resulting in invalid data for the week.
10/1/07
10/3/07
10/5/07
10/7/07
10/9/07
10/11/07
10/13/07
10/15/07
10/17/07
10/19/07
10/21/07
10/23/07
10/25/07
10/27/07
10/29/07
10/31/07
Date


Pond A18 and Artesian Slough Temperature Comparisons
May 2007
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Temperature (C)
4/30/07
5/2/07
5/4/07
5/6/07
5/8/07
5/10/07
5/12/07
5/14/07
5/16/07
5/18/07
5/20/07
5/22/07
5/24/07
5/26/07
5/28/07
5/30/07
Date



Pond A18 and Artesian Slough Temperature Comparisons
June 2007
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Temperature (C)
5/28/07
5/30/07
6/1/07
6/3/07
6/5/07
6/7/07
6/9/07
6/11/07
6/13/07
6/15/07
6/17/07
6/19/07
6/21/07
6/23/07
6/25/07
6/27/07
6/29/07
7/1/07
7/3/07
Date


Pond A18 and Artesian Slough Temperature Comparisons
July 2007
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
Temperature (C)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
7/2/07
7/4/07
7/6/07
7/8/07
7/10/07
7/12/07
7/14/07
7/16/07
7/18/07
7/20/07
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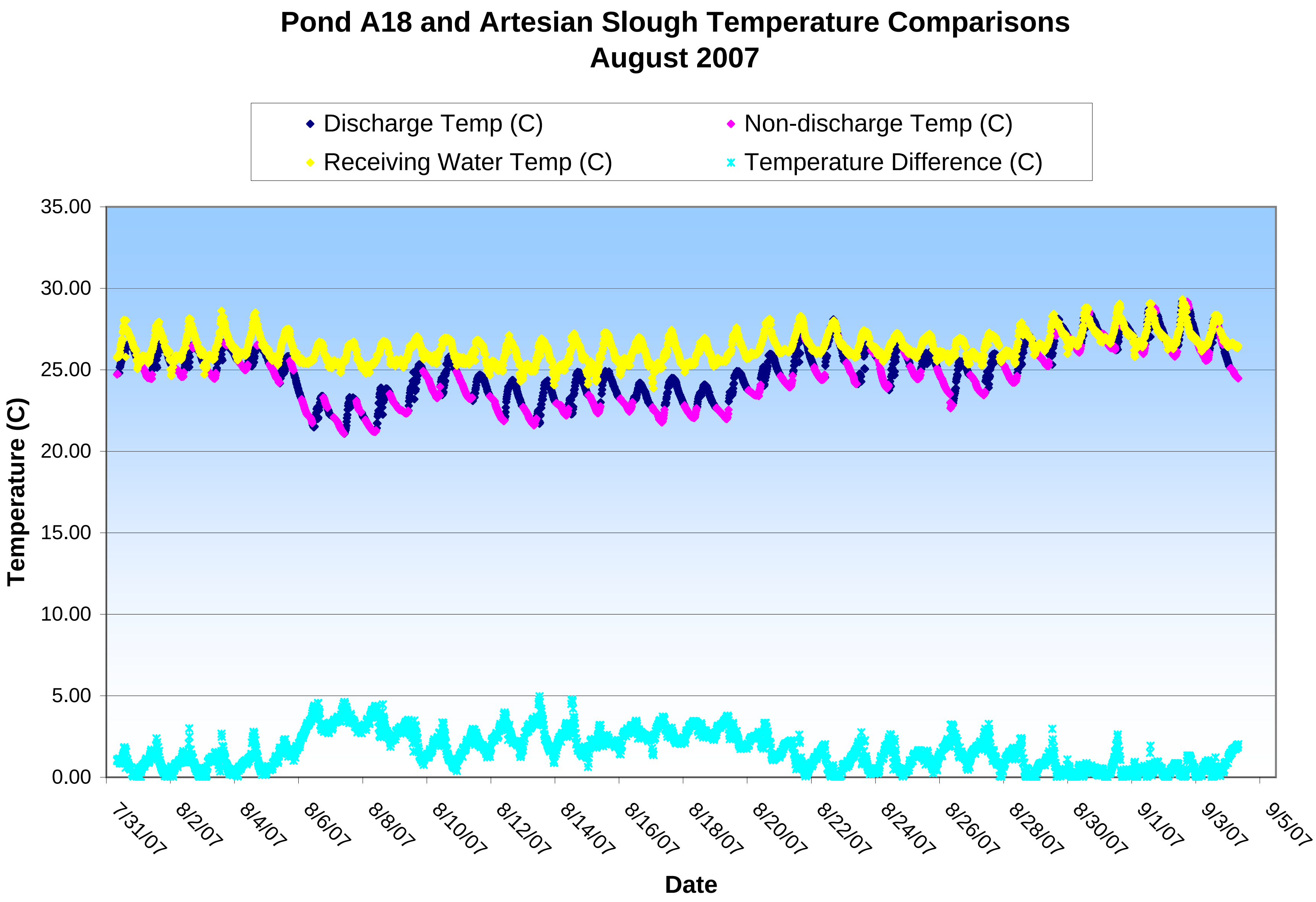
7/24/07
7/26/07
7/28/07
7/30/07
Date


Pond A18 and Artesian Slough Temperature Comparisons
August 2007
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
Temperature (C)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
7/31/07
8/2/07
8/4/07
8/6/07
8/8/07
8/10/07
8/12/07
8/14/07
8/16/07
8/18/07
8/20/07
8/22/07
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9/1/07
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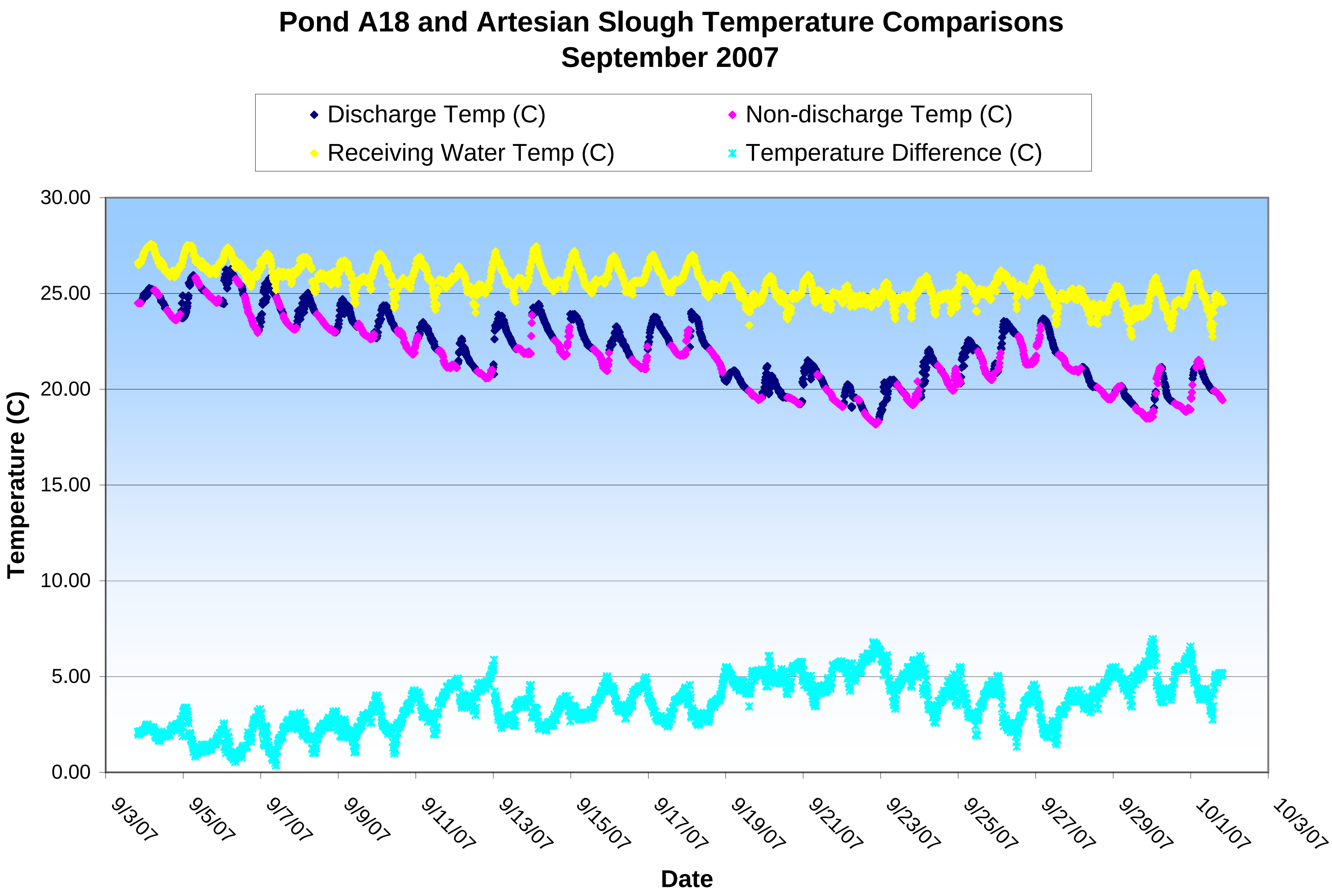
9/5/07
Date


Pond A18 and Artesian Slough Temperature Comparisons
September 2007
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
Temperature (C)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
9/3/07
9/5/07
9/7/07
9/9/07
9/11/07
9/13/07
9/15/07
9/17/07
9/19/07
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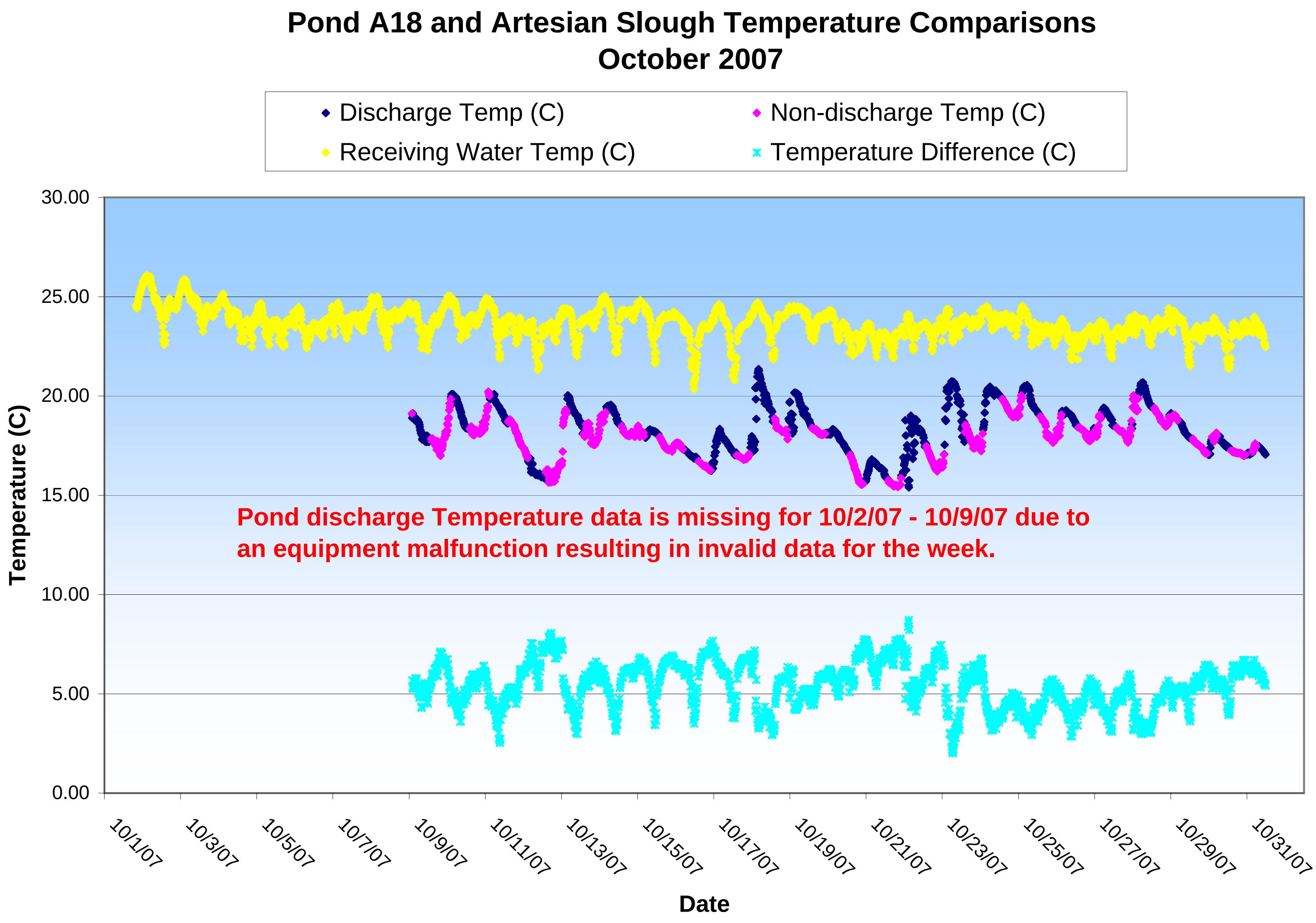
9/27/07
9/29/07
10/1/07
10/3/07
Date



Pond A18 and Artesian Slough Temperature Comparisons
October 2007
Discharge Temp (C)
Non-discharge Temp (C)
Receiving Water Temp (C)
Temperature Difference (C)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Temperature (C)
Pond discharge Temperature data is missing for 10/2/07 - 10/9/07 due to an equipment malfunction resulting in invalid data for the week.
10/1/07
10/3/07
10/5/07
10/7/07
10/9/07
10/11/07
10/13/07
10/15/07
10/17/07
10/19/07
10/21/07
10/23/07
10/25/07
10/27/07
10/29/07
10/31/07
Date

Appendix 4. Pond A18 Sediment Mercury Report

POND A18 SEDIMENT MERCURY REPORT

Prepared for:

The City of San Jose
Environmental Services Department
700 Los Esteros Road
San Jose, CA 95134

Prepared by:

KINNETIC LABORATORIES INCORPORATED

307 Washington Street
Santa Cruz, CA 95060

15 November 2007

Pond A18 Sediment Mercury Report

Kinnetic Laboratories, Inc.
15 November 2007

Table of Contents

List of Tables

List of Figures

Pond A18 Sediment Mercury Report

Kinnetic Laboratories, Inc.
15 November 2007

1.0 INTRODUCTION

In 2005, The City of San Jose purchased Salt Pond A18 from Cargill and has been managing the pond since October 2005. As part of the requirements in the A18 Waste Discharge Order (WDO), the City is required to perform in-pond sampling of A18 sediment to be analyzed for mercury, methyl mercury concentrations and related chemistry. The Self Monitoring Program (SMP) specifically states: *"The Discharger shall collect annual samples for mercury and methyl mercury in August or September of each year from Pond A18. In collecting mercury samples, the Discharger shall follow the guidelines in Section C of the SMP, and monitor for pH, TOC, sulfides and redox potential. Further, the Discharger shall report concentrations of mercury in mg/kg dry weight."*

2.0 METHODS

Sediment samples were collected from four locations (Figure 1) in Pond A18 on 25 September 2007. An additional sample, designated A18-5, was collected at the same location as sample A18-4 and submitted blindly to the analytical laboratory to help in better understanding the inherent variability in samples collected from the same location.

An inflatable kayak was used to access all sites. Sample locations were determined and recorded using a Lowrance iFinder handheld WAAS enabled GPS. Samples were collected by two methods. At sample site A18-4 (and blind field duplicate sample A18-5) a pre-cleaned stainless steel petite ponar grab was used. A pre-cleaned stainless steel core was used for the three sampling sites (A18-1, A18-2, and A18-3).

The ponar grab is a self-closing sampler using a spring loaded pinch-pin that releases when the sampler impacts the bottom and the lowering of line becomes slack. The top of each scoop has a removable stainless steel screen (583 micron) to allow water to flow through the sampler during descent. This lessens the frontal shock wave created by descent and reduces surface disturbance. Both screens are covered with neoprene rubber flaps that open during descent for water flow through, and close during retrieval to prevent sample wash out. In order to be considered acceptable, the grab samples were required to satisfy a set of quality criteria. Samples were rejected if the ponar grab did not close fully allowing sample to wash out or if removal of the overlying water resulted in significant wash out of sediment fines. Five successful grabs were needed for each sample to collect enough sediment for the analyses. Several grab attempts were rejected where large chunks of the gypsum crust prevented the ponar grab from fully closing. After the ponar grab was retrieved, the surface water was allowed to drain off and sediment was removed with a stainless steel spoon and placed in a Tefzel-coated compositing bucket. At site A18-4 penetration of the gypsum surface layer was possible with the ponar grab and the top 5-cm of sediment could easily be collected.

Figure 1. Sampling Locations for Pond A18, 25 September 2007.

The gypsum layer was too thick to allow penetration of the ponar grab at the other three sites. Positioning at these stations had to be partially based on finding an area where the gypsum layer was thin enough to be penetrated. A pre-cleaned stainless steel 4-inch diameter hand core was pushed into the sediment. A plastic cap was then place on the top end of the core to prevent loss of the sample and the core was pulled out of the sediment. On the surface the plastic cap was removed and the core was extruded allowing removal of the top 5-cm of the sample. Five cores were collected at each site and the top 5-cm of each core was placed in a Tefzel-coated compositing bucket.

All samples were composited in there own pre-cleaned Tefzel-coated compositing bucket. Very large chunks of gypsum and rock, where possible, were removed during the homogenization of the sample. It was still obvious that pieces of large material remained in the homogenized sample. The homogenized samples were than allocated into the appropriate pre-labeled sample jars using a stainless steel spoon. All sediment samples were analyzed for total mercury, methyl mercury, percent solids, pH, total organic carbon (TOC), total sulfides, redox potential, and particle size distribution. Each analytical laboratory provided sample containers for their appropriate analyses. An 8 oz. jar was provided for the total mercury, methyl mercury, and percent solids (for dry weight calculation) and a 16 oz. jar was provided for the pH, total organic carbon (TOC), total sulfides, redox potential, particle size, and percent solids (again for dry weight calculation). Samples were immediately placed on ice and then shipped under strict chain-of-custody procedures to the appropriate analytical laboratories on 26 September 2007. All samples were received by the analytical laboratories by 10:30 AM on 27 September 2007.

Total mercury (EPA 1631 Appendix), methyl mercury (EPA 1630 Mod.), and percent solids (EPA 160.3) were analyzed by Brooks Rand of Seattle, Washington. Percent solids (EPA 160.3M), pH (SM 9045C), TOC (ASTM D4129-82M), total sulfides (EPA 9030B Mod.), redox potential (ASTM D1498-00), and particle size distribution (ASTM D422 Mod.) were analyzed by Columbia Analytical Services, Inc. of Kelso, Washington.

Overlying water at each sampling location was sampled for temperature, dissolved oxygen (D.O.), pH, salinity, and redox potential. A YSI Model 63 handheld instrument was used to measure temperature (.C), pH (units), and salinity (ppt). A YSI Model 58 portable D.O. meter was used to measure D.O. in both mg/L and percent saturation. An Oakton ORPtestr 10 ORP meter was used to measure oxidation-reduction (redox) potential (mV).

3.0 RESULTS

Stations were located and sampled on 25 September 2007 between 14:10 and 16:30 PDT (Table 1). Station water characteristics were recorded at each sampling site (Table 2). In all cases the water turbidity was high and the color was brownish green. No unusual odors, trash, or any oil and grease sheen was observed.

Table 1. Station Locations and Sampling Times.

STATION	TIME (PDT)	LATITUDE	LONGITUDE
A18-1	16:30	37º 26' 43.1"	121º 57' 02.7"
A18-2	14:55	37º 26' 56.4"	121º 57' 19.3"
A18-3	13:30	37º 27' 14.5"	121º 57' 35.2"
A18-4	14:10	37º 27' 33.0"	121º 57' 38.7"

Table 2. Station Water Characteristics.

STATION	TURBIDITY	OIL & GREASE SHEEN	TRASH	COLOR	ODORS
A18-1	HIGH	NONE	NONE	BROWNISH/GREEN	NONE
A18-2	HIGH	NONE	NONE	BROWNISH/GREEN	NONE
A18-3	HIGH	NONE	NONE	BROWNISH/GREEN	NONE
A18-4	HIGH	NONE	NONE	BROWNISH/GREEN	NONE

3.1 Water Quality Parameter Field Measurements:

Overlying water quality field measurements are presented in Table 3. Depth ranged from 1.5 feet at station A18-2 to 2 feet at all other stations. pH ranged from 7.8 (A18-4) to 8.3 (A18-2). Temperature increased slightly going from north (A18-4 at 20.8 .C) to south (A18-1 at 22.8 .C) but may likely be a reflection of warming water temperatures during the day as sampling was conducted in the same direction. Dissolved oxygen varied from 9.6 mg/L (109% saturation) at A18-4 to 18.6 mg/L (>200% saturation) at A18-3. Algal blooms and oxygen supersaturation was visibly apparent at most sites, especially A18-3. ORP ranged from 248 mV (A18-2) to 275 mV (A18-3). Salinity increased from north to south ranging from 25.2 ppt (A18-4) to 27.8 ppt (18-1).

Table 3. Station Water Quality Parameter Field Measurements.

STATION	WATER DEPTH (feet)	pH (units)	TEMP. (ºC)	D.O. (mg/L)	D.O. (% Saturation)	ORP (mV)	SALINITY (ppt)
A18-1	2	8.2	22.8	10.6	125	251	27.8
A18-2	1.5	8.3	22.5	14.6	170	248	27.4
A18-3	2	8.2	21.3	18.6	>200	275	25.6
A18-4	2	7.8	20.8	9.6	109	270	25.2

3.2 Sediment Quality Analytical Measurements:

Analytical results for sediment samples are presented in Table 4. Total mercury in sediment ranged from 0.066 mg/kg (dry wt.) at A18-3 to 0.512 mg/kg (dry wt.) at A18-2. Methyl mercury in sediment ranged from 0.000149 mg/kg (dry wt.) at A18-1 to 0.00442 mg/kg (dry wt.) at A18-5 (blind field duplicate at A18-4). Note that A18-4, like A18-5, also had a relatively high methyl mercury level of 0.003194 mg/kg (dry wt.) both an order of magnitude higher than all other samples.

Table 4. Analytical Results for Sediment Samples.

	SAMPLING STATIONS				
ANALYTE	**A18-1**	**A18-2**	**A18-3**	**A18-4**	**A18-5***
Total Mercury					
mg/kg dry weight	0.304	0.512	0.066	0.200	0.232
ng/g dry weight	304	512	66	200	232
Methyl Mercury					
mg/kg dry weight	0.000149	0.000155	0.000184	0.003194	0.004420
ng/g dry weight	0.149	0.155	0.184	3.194	4.420
% Solids (Brooks Rand – Mercury Samples)	40.2	33.0	41.4	38.2	36.2
% Solids (Columbia Analytical – Conventionals)	26.5	25.6	32.6	16.9	18.9
TOC (% dry wt.)	3.11	3.67	8.01	3.89	3.38
ORP (millivolts)	-36.8	-89.4	119	-47.7	-76.2
pH (units)	7.84	7.73	8.06	7.97	7.99
Total Sulfide (mg/kg dry wt.)	2540	3330	404	1840	1660
Particle Size Distribution (%)					
Gravel, Medium	32.8	20.1	28.9	18.2	2.49
Gravel, Fine	5.87	7.93	27.8	9.15	1.01
Sand, Very Coarse	4.84	5.66	19.1	5.11	1.45
Sand, Coarse	3.56	3.64	12.9	2.89	1.39
Sand, Medium	2.65	2.37	6.79	1.39	0.97
Sand, Fine	3.49	3.01	5.65	1.45	1.24
Sand, Very Fine	1.01	0.82	1.17	0.37	0.39
Silt	35.1	44.3	7.05	57.7	52.3
Clay	11.4	16.3	7.84	24.3	25.7

* A18-5 = Field Duplicate of Station A18-4 Submitted Blindly to the Analytical Laboratory.

Station A18-3 appears to be the most different station from all other stations. Although the methyl mercury levels were similar to A18-1 and A18-2, total mercury was an order of magnitude less than those two stations. In addition at A18-3, TOC was twice the level of any other station, ORP was positive, and total sulfide was the lowest level measured. Finally, there was a greater amount of sand present at this station and a very low amount of silt.

4.0 QUALITY ASSURANCE/QUALITY CONTROL

Kinnetic Laboratories conducts its activities in accordance with formal QA/QC procedures. The objectives of the QA/QC Program are to fully document the field and laboratory data collected, to maintain data integrity from the time of field collection to storage at the end of the project, and to produce the highest quality data possible. The program is designed to allow data to be assessed by the following parameters: Precision, Accuracy, Comparability, Representativeness, and Completeness.

Field Quality Control includes adherence to formal sample documentation and tracking. Analytical chemistry Quality Control is formalized by EPA and State Certification agencies, and involves internal quality control checks such as method blanks, matrix spike/spike duplicates (MS/MSDs), blank spike/blank spike duplicates, laboratory replicates, calibration standards, and certified reference materials (CRMs).

All analytical data collected for this sediment-testing program underwent QA/QC evaluation according to EPA National Functional Guidelines for inorganic data review (USEPA, 2002).

4.1 Holding Times

All analytical tests were performed within holding times.

4.2 Blanks

Method blanks were run to assess contamination introduced in the laboratory. In all cases, procedural blanks for sediment did not contain any quantifiable concentrations indicating the methods and equipment used were free of or did not introduce contamination. Mercury and methyl mercury was detected in all method blanks performed by Brooks Rand (Table 5). In the case of mercury, the average of the four method blanks was greater than two times the MDL (Method Detection Limit) and the standard deviation was greater than two-thirds the MDL, however, the highest method blank was less than one-tenth of the associated sample results, satisfying the secondary acceptance criteria. In the case of methyl mercury, the average of the four method blanks was less than two times the MDL and the standard deviation was less than two-thirds of the MDL satisfying both of the primary acceptance criteria. Method blanks performed by Columbia Analytical Services, Inc. for total sulfide and TOC were all non-detects (Table 6).

Table 5. Method Blank Results for Brooks Rand Sediment Sample Analyses.

METHOD BLANK	MERCURY (ng/g)	METHYL MERCURY (ng/g)	PERCENT SOLIDS (%)
MB1	0.15	0.011	0.00
MB2	0.05	0.004	0.00
MB3	0.02	0.004	-
MB4	0.05	0.004	-
Average	0.07	0.006	0.00
Standard Deviation	0.06	0.004	0.00
Method Detection Limit	0.03	0.008	0.08
Criteria	Avg.<2X MDL, Std Dev <2/3 MDL or Results >10X Highest Blank	Avg.<2X MDL, Std Dev <2/3 MDL	<MDL or <1/10th sample

Table 6. Method Blank Results for Columbia Analytical Services, Inc. Sediment Sample Analyses.

METHOD BLANK	TOTAL SULFIDE (mg/kg)	TOTAL ORGANIC CARBON (%)
MB1	ND	ND
MB2	ND	-
Method Reporting Limit	3.0	0.05

ND = analyte not detected at or above the associated method reporting limit.

4.3 Laboratory Replicates

Laboratory replicates were performed on field samples. Sediment RPDs met QA/QC objectives with the exception of total sulfide (21% RPD) which was just slightly above the control limit of [a] 20% (Table 7). No qualification of total sulfide data was performed as all other associated QC samples were within their appropriate control limits.

Table 7. Laboratory Replicate Results.

ANALYTE	SAMPLE VALUE	DUPLICATE VALUE	AVERAGE VALUE	DUPLICATE RPD	CONTROL LIMITS
Mercury (ng/g – wet weight)	5.9	6.1	6.0	3%	≤ 30%
Mercury (ng/g – wet weight)	169	187	178	10%	≤ 30%
Methyl Mercury (ng/g – wet weight)	0.051	0.058	0.055	13%	≤ 35%
Percent Solids (%)	40.17	44.39	42.28	10%	≤ 15%
pH (units)	7.84	7.83	7.84	< 1%	≤ 20%
ORP (mV)	-36.8	-39.5	-38.2	7%	≤ 20%
Total Sulfide (mg/kg)	2540	3140	2840	21%	≤ 20%
Total Organic Carbon (%)	0.19	0.17	0.18	11%	≤ 20%

4.4 Laboratory Control Samples

Laboratory Control Samples (LCSs) were run by Columbia Analytical Services, Inc. for pH, ORP, Total Sulfide, and TOC (Table 8). All LCS recoveries were within established Control Limits indicating proper analytical performance in the absence of matrix effects.

Table 8. Laboratory Control Sample Results.

ANALYTE	TRUE VALUE	RESULT	PERCENT RECOVERY	CONTROL LIMITS
pH (units)	8.16	7.96	98%	85-115%
ORP (mV)	480	479	100%	85-115%
Total Sulfide (mg/kg)	7.4	5.8	78%	60-130%
Total Sulfide (mg/kg)	7.4	6.0	81%	60-130%
Total Organic Carbon (%)	0.89	0.86	97%	85-115%

4.5 Matrix Spike/Matrix Spike Duplicates

Matrix Spike and Matrix Spike Duplicates (MS/MSD) percent recoveries were evaluated to determine acceptable accuracy based on method-specific percent recoveries. The general rule is that when spikes are reported below the accepted range they indicate a low bias to the results and when reported above the accepted range they indicate a high bias. However, if the spike concentration was low in comparison with the sample concentration, a poor recovery is not in itself indicative of a QC problem. All MS/MSD recoveries met established QC objects (Table 9).

As another measure of precision, the RPD between MS/MSD recovery results were evaluated. In all cases, calculated RPDs were below their associated Control Limits.

Table 9. Matrix Spike/Matrix Spike Duplicate Results.

ANALYTE	MATRIX SPIKE				MATRIX SPIKE DUPLICATE				CONTROL LIMITS	
	SAMP. VALUE	SPIKED VALUE	MEASUR. VALUE	% RECOV.	SPIKED VALUE	MEASUR. VALUE	% RECOV.	DUP. RPD (%)	% RECOV.	RPD
Mercury (ng/g-wet wt.)	5.9	99.7	122.3	117%	97.4	113.9	111%	7%	70-130%	≤ 30%
Mercury (ng/g-wet wt.)	169	470	725	118%	426	645	112%	12%	70-130%	≤ 30%
Methyl Mercury (ng/g-wet wt.)	0.051	1.860	1.649	86%	1.983	1.641	80%	0%	65-135%	≤ 35%
Total Sulfide (mg/kg)	2540	2330	5710	136%					46-144%	
Total Organic Carbon (%)	0.19	1.90	1.84	87%					75-125%	

4.6 Certified Reference Material

All certified reference material (CRM) percent recoveries for this project were well within QC limits indicating proper analytical performance in the absence of matrix effects (Table 10).

Table 10. Certified Reference Material Results.

ANALYTE	CRM ID	CERTIFIED VALUE	MEASURED VALUE	% RECOVERY	CONTROL LIMITS
Mercury (ng/g – wet weight)	MESS-3	91	107	118%	75-125%
Methyl Mercury (ng/g – wet weight)	CC580	75	62	83%	65-135%

4.7 Mercury Analyses Instrument Calibration

Method requirements for satisfactory instrument calibration are established to ensure that the instrument is capable of producing acceptable quantitative data for mercury. Initial Calibration Verification (ICV) demonstrates that the instrument is capable of acceptable performance at the beginning of the analytical run. Continuing Calibration Verification (CCV) demonstrates that the initial calibration is still valid by checking the performance of the instrument on a continuing basis.

All ICV and CCV percent recoveries for this project were well within QC limits indicating proper that the instrument produced acceptable quantitative data (Table 11).

Table 11. Initial Calibration and Continuing Calibration Verification Results for Mercury Analyses.

QUALITY CONTROL SAMPLE ID	CERTIFIED VALUE	MEASURED VALUE	% RECOVERY	CONTROL LIMITS
Mercury (ng/L)				
ICV[1]	16.01	16.11	101%	85-115%
CCV1	5.00	4.96	99%	77-123%
CCV2	5.00	5.06	101%	77-123%
CCV3	5.00	5.13	103%	77-123%
Methyl Mercury (ng/L)				
ICV[2]	7.33	7.03	96%	80-120%
CCV1	0.625	0.551	88%	67-133%
CCV2	0.625	0.652	104%	67-133%
CCV3	0.625	0.679	109%	67-133%

1 = Preparation of the CRM NIST 1641d.
2 = ICV standard is prepared from an aliquot of the CRM DORM-2.

4.8 Field Replicate Analysis

Table 11 presents a summary of RPDs respectively for field replicate samples (submitted blind to the analytical laboratories) from the sampling event on 25 September 2007. Strict criteria are not established for evaluation of field duplicates. Instead, these samples are evaluated based upon best professional judgment. As a general guideline, RPDs greater than 50% were considered to be of potential concern provided both values were greater than five times the reporting limit. In cases where one or both values were less than five times the reporting limit, then those values were considered to be of potential concern if the difference between the two values were greater than twice the reporting limit.

With the exception of the particle size distribution of coarse sand to medium gravel, all other field replicates were within the 50% guideline. Medium sand through silt and clay were within the 50%

guideline. The collection of these two samples shows that the sediment is not homogeneous, in relation to large particles in the localized area.

Table 12. Summary of Field Replicate Sample (submitted blind to analytical laboratory) Results in Association with Sediment Sampling (25 September 2007).

ANALYTE	Original Sample Concentration A18-4	Duplicate Sample Concentration A18-5	RPD
Total Mercury			
mg/kg dry weight	0.200	0.232	15
Methyl Mercury			
mg/kg dry weight	0.003194	0.004420	32
% Solids (Brooks Rand – Mercury Samples)	38.2	36.2	5
% Solids (Columbia Analytical – Conventionals)	16.9	18.9	11
TOC (% dry wt.)	3.89	3.38	14
ORP (millivolts)	-47.7	-76.2	46
pH (units)	7.97	7.99	0
Total Sulfide (mg/kg dry wt.)	1840	1660	10
Particle Size Distribution (%)			
Gravel, Medium	18.2	2.49	152
Gravel, Fine	9.15	1.01	160
Sand, Very Coarse	5.11	1.45	112
Sand, Coarse	2.89	1.39	70
Sand, Medium	1.39	0.97	36
Sand, Fine	1.45	1.24	16
Sand, Very Fine	0.37	0.39	5
Silt	57.7	52.3	10
Clay	24.3	25.7	6

4.9 QA/QC Conclusions

A careful review of the results confirmed that the laboratories met QA/QC requirements. Overall evaluation of the QA/QC data indicates that the chemical data are within established performance criteria and can be used for general characterization of sediments in the proposed project area. No data were subjected to qualification as a result of quality control objectives not being met.

Appendix 5. Communications Summary during 2007 A18 Monitoring

A18 2007 Communications with Regional Water Board and Others

Date	Person(s) Contacted	Type of Communication	Reason for Notification and Action
3/29	Numerous	Meeting	Meeting with regulatory agencies to receive input on Opportunities and Constraints Report as well as future regulatory issues regarding the A18 and Plant Master Planning processes. More detail regarding planning is included in Appendix 6.
5/8	Robert Schlipf	e-mail	Transmitted 1st week of monitoring data – no triggers or exceedances.
5/10	Eric Mruz (USFWS)	e-mail	Discussion regarding differences in winter operations between A18 and A16/A17 that would account for differences in initial salinity.
5/15	Robert Schlipf	e-mail	Transmitted 2nd week of monitoring data – no triggers or exceedances.
5/22	Robert Schlipf	e-mail	Transmitted 3rd week of monitoring data – no triggers or exceedances.
5/29	Robert Schlipf	e-mail	Transmitted 4th week of monitoring data – no triggers or exceedances.
6/5	Robert Schlipf	e-mail	Transmitted 5th week of monitoring data – no triggers or exceedances.
6/12	Robert Schlipf	e-mail	Transmitted 6th week of monitoring data – no triggers or exceedances.
6/19	Robert Schlipf	e-mail	Transmitted 7th week of monitoring data – no triggers or exceedances.
6/22	Robert Schlipf	e-mail	Transmitted two months of discrete transect data from Artesian Slough.
6/26	Robert Schlipf	e-mail	Transmitted 8th week of monitoring data – no triggers or exceedances.
7/3	Robert Schlipf	e-mail	Transmitted 9th week of monitoring data – no triggers or exceedances.
7/10	Robert Schlipf	e-mail	Transmitted 10th week of monitoring data – no triggers or exceedances.
7/17	Robert Schlipf	e-mail	Transmitted 11th week of monitoring data – DO trigger, 10th percentile at 2.6 mg/L. Initiated discharge timing with 6 hrs/day closures.
7/24	Robert Schlipf	e-mail	Transmitted 12th week of monitoring data – no triggers or exceedances. Maintained operations for discharge timing. Transmitted three months of discrete transect data from Artesian Slough.
8/2	Robert Schlipf	e-mail	Transmitted 13th week of monitoring data – DO trigger, 10th percentile at 2.3 mg/L. Increased closure time to 8 hrs/day.

Date	Person(s) Contacted	Type of Communication	Reason for Notification and Action
8/8	Robert Schlipf	e-mail	Transmitted 14^{th} week of monitoring data – no triggers, but DO in the receiving water and discharge was < 5.0mg/L at the same time. Increased gate closure time to 9 hrs/day.
8/15	Robert Schlipf	e-mail	Transmitted 15^{th} week of monitoring data – no triggers or exceedances. Maintained operations for discharge timing.
8/16	Robert Schlipf and Regional Water Board Staff, USFWS, USGS and DFG staff	Meeting	Discussed Annual Reports from various agencies. Compared and shared management strategies related to management and operations of former salt ponds. Presented the Opportunities and Constraints Report (see Appendix 6) for A18 Planning Process.
8/21	Robert Schlipf	e-mail	Transmitted 16^{th} week of monitoring data – no triggers or exceedances. Decreased closure time to 8 hrs/day.
8/28	Robert Schlipf	e-mail	Transmitted 17^{th} week of monitoring data – no triggers or exceedances. Maintained operations for discharge timing.
9/4	Robert Schlipf	e-mail	Transmitted 18^{th} week of monitoring data – no triggers or exceedances. Reported stressed fish. Maintained operations for discharge timing.
9/11	Robert Schlipf	e-mail	Transmitted 19^{th} week of monitoring data – DO trigger, 10^{th} percentile at 1.8 mg/L. Increased closure time to 10 hrs/day.
9/18	Robert Schlipf	e-mail	Transmitted 20^{th} week of monitoring data – no triggers or exceedances. Decreased closure time to 8 hrs/day.
9/27	Robert Schlipf	e-mail	Transmitted 21^{st} week of monitoring data – DO trigger, 10^{th} percentile at 2.5 mg/L. Increased closure time to 11 hrs/day.
10/3	Robert Schlipf	e-mail	Transmitted 22^{nd} week of monitoring data – DO trigger, 10^{th} percentile at 1.3 mg/L. Increased closure time to 12 hrs/day.
10/10	Robert Schlipf	e-mail	Transmitted 23^{rd} week of monitoring data – no reportable Pond data due to an equipment failure. Maintained 12 hrs/day closure.
10/16	Robert Schlipf	e-mail	Transmitted 24^{th} week of monitoring data – no triggers or exceedances. Decreased closure time to 8 hrs/day.

Date	Person(s) Contacted	Type of Communication	Reason for Notification and Action
10/23	Robert Schlipf	e-mail	Transmitted 25th week of monitoring data – DO trigger, 10th percentile at 2.4 mg/L. Increased closure time to 11 hrs/day.
11/1	Robert Schlipf	e-mail	Transmitted 26th (final) week of monitoring data – no triggers or exceedances. Began winter or wet-season operations of Pond A18.

Appendix 6. Status Report on A18 Long-term Operations.

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STATUS REPORT ON A18 LONG TERM OPERATIONS

Pursuant to Order No. R2-2005-0003, Provision 6, the Discharger shall submit a status report that describes how it proposes to modify operating Pond A18. The status report shall describe the planning effort for potential uses of Pond A18, as well as a timeline for implementing the transition from lagoon management to future uses of A18. The status report will also describe how the potential uses for Pond A18 will achieve protection of water quality and beneficial uses. The following serves as the required status report.

During the last three years, progress was made to plan for future uses of Pond A18. The planning process has two components:

1. The development of an opportunities and constraints report for Pond A18; and
2. The initiation of a Master Planning process for the San Jose/Santa Clara Water Pollution Control Plant, which will include land use planning and A18.

Opportunities and Constraints Report

The City of San Jose contracted with H.T. Harvey & Associates to develop an Existing Conditions and Opportunities and Constraints report for Pond A18. A separate report covering the buffer lands was also prepared. Both reports were completed in January 2007 and are available at www.sanjoseca.gov/esd/plantmasterplan/default.asp.
(Executive Summary from A18 Report attached)
The report identified eight land use opportunities for A18:

1. Tidal Marsh Restoration
2. Flood Protection Improvements
3. Tidal Wetlands Mitigation Banking
4. Pulsed-discharge Wastewater Wetlands
5. Conventional Wastewater Wetlands
6. Managed Pond for Shorebirds
7. Relocate/Expand Biosolids Lagoons and Drying Beds
8. Public Access and Environmental Education

Each of these opportunities was evaluated to determine potential constraints and how well the opportunities served the land use planning goals for the Plant. The draft land use planning goals for the Plant are:

1. Flexibility for Plant uses: The highest priority land uses are those that directly support the Plant's operational needs.
2. Regulatory Compliance
3. Worker and Community Safety
4. Habitat Protection and Restoration
5. Good Neighbor/Public Value
6. Economic Opportunities

On March 29, 2007 City staff provided an overview of the report to regulatory agencies. Attendees provided general feedback on the opportunities and constraints as well as future regulatory issues. Agency staff expressed interest in remaining involved in the Plant's planning process. The meeting was attended by staff from the following agencies and organizations: Wildlife Stewards, ABAG/Bay Trail, County Vector Control, US EPA, Santa Clara Valley Water District, Coastal Conservancy, Bay Area Air Quality Management District, U.S. Army Corps of Engineers, and Plant tributary agencies. Feedback included the importance of public access and trails, flood protection, integration with tidal marsh restoration and the potential for wetland mitigation banking. In addition, City staff met with Regional Water Board, USFWS, and DFG staff on August 16, 2007 to provide an overview of the report as well as the Plant Master Plan process.

<u>Plant Master Plan Process</u>

Building on the work in the A18 and buffer land reports, the Plant Master Plan is a three-year planning effort that will direct the development of Plant facilities, operations, land-use, staffing, and financing, for the next 30 years. The Plant Master Plan will guide the Plant's development towards a more sustainable operation by linking the facilities and the land use planning to achieve multiple benefits and multiple objectives for the natural community, neighbors, and ratepayers.

To help determine the communities' values, the Plant is engaging in an extensive outreach effort for the Plant Master Plan beginning in May 2008. The Plant Master Plan, along with the environmental review documents, is scheduled to be completed in 2011.

As part of this planning effort, the future uses for Pond A18 will be identified. Water Quality and beneficial use protection will be essential elements in determining appropriate uses as will be realizing operational and regulatory benefits for the Plant. Until the Plant Master Plan is completed, Pond A18 will continue to operate as a managed pond.

SAN JOSÉ/SANTA CLARA
WATER POLLUTION CONTROL PLANT/
POND A18 MASTER PLANNING

POND A18 EXISTING CONDITIONS
AND OPPORTUNITIES AND
CONSTRAINTS ASSESSMENT
FINAL

Prepared by:

H.T. Harvey & Associates

In Collaboration With:

Philip Williams & Associates

CH2MHILL

David Powers & Associates

Prepared for:

City of San José
Department of Environmental Services
200 East Santa Clara Street, 10th Floor
San José, California 95113

January 30, 2007

Project No. 2525-01

EXECUTIVE SUMMARY

The City of San José (City) is in the early stages of developing a comprehensive Land-Use Master Plan for the San José/Santa Clara Water Pollution Control Plant (Plant) lands, including Pond A18. The Land-Use Master Plan will identify viable land-use alternatives over a 50-year planning horizon. The overall planning goal is to support present and future Plant operations in a manner that complies with environmental regulations and is consistent with the City's 2020 General Plan and the Alviso Master Plan. The approximately 2,680-acre planning area is located in northern San José and includes the Plant Lands (~1,854 acres) and Pond A18 (~826 acres). This report characterizes the existing conditions and land-use opportunities and constraints associated with Pond A18.

PRIMARY LAND-USE CONSTRAINTS

The report identifies primary land-use constraints that will ultimately shape the development of land-use alternatives at Pond A18. The following are the most substantive of these constraints.

San José 2020 General Plan. Pond A18 is located outside of the San José 2020 General Plan Urban Growth Boundary, which precludes urban development within the pond. Additionally, the General Plan's Private Open Space designation would allow only very low-intensity uses.

Flood Control. The 1988 U. S Army Corps of Engineers (USACE) South San Francisco Bay Shoreline Study (USACE 1988) showed that the inboard levee between Pond A18 and Plant Lands and flood detention in Pond A18 are expected to protect adjacent portions of Plant Lands from the 100-year coastal flood event. Future Pond A18 land-uses would need to maintain existing levels of flood protection to avoid worsening flood hazards for Plant Lands and adjacent areas. The inboard levee at Pond A18 is owned by the City of San José and will need to be maintained, unless other flood control measures are implemented.

Non-engineered Levees. Non-engineered levees comprise the majority of the perimeter levees around Pond A18. The top of the non-engineered levee surface does not provide an all-weather surface, making it unsuitable for vehicular access. Limited access makes it difficult to maintain the pond, existing drainage systems, and levee structure.

Jurisdictional Habitat. Pond A18 likely falls under the jurisdiction of the USACE, the San Francisco Bay Conservation and Development Commission (BCDC) and the San Francisco Bay Regional Water Quality Control Board (RWQCB). These agencies would require mitigation to implement alternatives that would place fill within the pond.

PG&E Transmission Tower. A PG&E transmission tower and associated easement bifurcates the pond. The existing structures include a boardwalk, abutments, towers and old abandoned remnant pilings. The ultimate use of the pond must accommodate the fixed infrastructure and maintain access to these PG&E facilities.

LAND-USE OPPORTUNITIES

Eight land-use opportunities were identified for Pond A18 and are briefly summarized below.

Tidal Marsh Restoration. Restoration of tidal marsh within Pond A18 would likely move the salinity gradient in the far South Bay and Coyote Creek further upstream, converting existing tidal brackish marsh to tidal salt marsh along Coyote Creek and Coyote Slough. Restored tidal salt marsh could also potentially establish in portions of Pond A18. Taking such actions to restore tidal salt marsh within the South Bay could reduce or eliminate future salt marsh mitigation requirements associated with increased freshwater effluent discharge. Surplus restored salt marsh could be banked to compensate for future impacts due to Plant expansion and increased discharge needs.

Tidal marsh restoration would require improvements to the inboard pond levee to control coastal flooding. An opportunity also exists to restore a broad tidal marsh-upland transition zone (ecotone) adjacent to the improved levee. This restored habitat feature would provide high-tide refugia for tidal marsh animal species. Biosolids or co-compost could potentially be utilized as fill to create this transition zone.

Flood Protection Improvements- South San Francisco Bay Shoreline Study. The USACE and non-federal partners are beginning a Feasibility Study for an updated South San Francisco Bay Shoreline Study that includes Plant lands and Pond A18. The goals of the 2006 Shoreline Study are flood damage reduction and ecosystem restoration along the South San Francisco Bay shoreline. The opportunity exists for the City to partner and cost-share with the USACE in planning, design, and implementation of flood protection and habitat restoration. In contrast to the current non-engineered levees around the southern and western perimeter of Pond A18, the future shoreline levee would be an engineered levee providing 100-year flood protection that would meet Federal Emergency Management Agency (FEMA) standards.

Tidal Wetlands Mitigation Banking. An opportunity exists to use a portion of Pond A18 to develop a tidal wetlands mitigation bank. Tidal wetland mitigation credits, beyond that needed to compensate for impacts due to Master Plan implementation and future potential Plant wastewater discharge impacts, could be sold to private or governmental project proponents. Revenue generated from the mitigation bank could be used to offset operational costs of the Plant. However, the market for tidal wetland mitigation in the South San Francisco Bay (South Bay) will be substantially reduced if the SBSP Restoration Project is implemented.

Pulsed-discharge Wastewater Wetlands. All or portions of Pond A18 could be converted to a pulsed-discharge wastewater wetland. A pulsed-discharge wetland is a constructed wetland designed to provide tertiary wastewater treatment while minimizing the freshwater impacts of effluent discharge on downstream tidal salt marsh habitat. Pulsed-discharge wastewater wetlands would detain freshwater effluent during the incoming tide and discharge the effluent during the outgoing tide, potentially protecting tidal salt marsh habitat even with increased effluent discharges. Treatment wetlands would also filter nutrients and heavy metals improving effluent water quality. Such treatment wetlands could potentially substitute for the Plant's existing tertiary treatment system; however this would require further assessment to determine if a wastewater wetland treatment system in Pond A18 could meet the RWQCB's pollutant discharge limits. Conversion of Pond A18 to a wastewater treatment wetland would provide flexibility for future Plant uses since a wastewater wetland, unlike a restored tidal salt marsh, would not provide habitat for federally-listed endangered species.

Conventional Wastewater Wetlands (not Pulsed-discharge). Conventional wastewater wetlands with a continuous discharge to the South Bay could also be installed in all or portions of Pond A18, if protection of downstream tidal salt marshes from increased freshwater discharge is not an issue in the future. Similar to pulsed-discharge wastewater wetlands, conventional wastewater wetlands could provide efficient pollutant filtration, removing nutrients and heavy metals. Due to the simplified water-level management, a conventional system would likely cost less than a pulsed-discharge system to design, install, and maintain. Like the pulsed-discharge option above, conventional wastewater wetlands would allow for future land-use flexibility within Pond A18 since they would not provide habitat for federally-listed endangered species. Such wetlands would also provide wildlife habitat, aesthetic values and environmental education opportunities.

Managed Pond for Shorebirds. Pond A18 could be managed as a shallow water (<15 cm) pond with islands to provide shorebird nesting, roosting, and foraging habitat. The conversion of Pond A18 to a managed pond for shorebirds would achieve far fewer of the City's land-use planning goals than the options described above. The benefits of this opportunity to the Plant are less tangible than the other opportunities because the primary benefit to Plant flexibility is contingent on external forces associated with the SBSP Restoration Project. The SBSP Restoration Project is seeking to strike a healthy balance in the South Bay between restored tidal salt marsh habitat and managed pond habitat. If the SBSP Restoration Project is limited to the Managed Pond Emphasis Alternative, then conversion of Pond A18 to a managed pond could allow the SBSP Restoration Project to restore a greater surface area of tidal salt marsh restoration to the west along Alviso Slough and Coyote Creek. Such tidal salt marsh restoration in the South Bay could, in addition to all the other benefits of tidal restoration, contribute to the recovery of the salt marsh harvest mouse and California Clapper Rail thus providing greater flexibility to the Plant with respect to freshwater discharges to the South Bay. As such, this option could potentially be used to mitigate future impacts on salt marsh habitat in the event that the Plant needed to dramatically increase freshwater effluent discharge to the Bay in the future. In addition, if Pond A18 were utilized to help establish that balance of wetland habitat types, the regulatory agencies would have a vested interest in maintaining the pond for shorebirds in the long-term.

Relocate/Expand Biosolids Lagoons and Drying Beds. The existing biosolids lagoons and drying beds are a source of odors that can be detected offsite to the east/southeast in nearby portions of Milpitas. All or a portion of lagoons and drying beds could be relocated to a new site within Pond A18, which would require partitioning of the pond using levees. The drying beds could be relocated without relocating the lagoons, but they should remain adjacent to one other. In addition, Pond A18 could be utilized as a site for the expansion of lagoons and drying beds, if additional space were needed for future sludge management.

Public Access and Environmental Education. An opportunity for an alternative alignment for the future San Francisco Bay Trail Primary Bay Spine exists along the future Shoreline Levee that would likely be located along the southern perimeter of Pond A18. This future engineered levee could provide a relatively wide and even surface for pedestrians along the southern perimeter of the San Francisco Bay. This alignment would connect the proposed short spur terminating at the Don Edwards National Wildlife Refuge Environmental Education Center to the existing Bay trail along the east side of Coyote Creek. This alignment would be safer for the public and far more aesthetic than the Primary Bay Spine proposed in the City's Bay Trail Master Plan along Zanker Road with its refuse/recycling materials truck traffic (Amphion Environmental 2002). In addition, two Bay Trail Spur Extensions options were identified. First, the 7,500-foot long public recreation easement on the Coyote Creek Flood Bypass levee located along the north side of Pond A18 presents a spur trail opportunity. Second, this spur trail along the Flood Bypass Levee could be extended down the west side of Pond A18. Levee trails could also provide a platform for environmental education via guided tours and educational signage.

Any new trails would have to be located and managed very carefully to maintain Plant security and flexibility and to ensure public safety. Access to the spur trails could be reserved for guided environmental education tours if the Plant determines that unsupervised access would pose a security threat to Plant operations or a safety hazard to the public.

The locations of trails in the vicinity of the Plant would be an opportunity for the Plant to be a good neighbor and also to inform the community about the primary purpose of the Plant facilities through educational programs and signage. In addition, any habitat restoration done on Plant lands could be described along trail routes and add to the profile of the Plant as a good neighbor. The public value of these facilities would be enormous, providing the public opportunities for environmental education, healthy exercise, and aesthetic enjoyment, as well as providing the public with an appreciation of the Plant's importance to an economically viable and healthy community.

OPPORTUNITIES RATING

The development of land-use alternatives will involve selecting and combining opportunities to create land-use alternatives that respond to varying degrees to the project's land-use planning goals. To assist with this process, the matrix below provides a qualitative rating of each opportunity relative to the project's land-use planning goals. The opportunities were rated in a collaborative meeting with representatives from City Staff, the West Valley Sanitation District, and H. T. Harvey & Associates. While many of the opportunities may provide negative or positive impacts that could be extrapolated to the City or County, the ratings were determined solely on the basis of their net impact as related to the Plant lands.

The rating scale was defined as follows:

0	=	No net impact (or neutral impact) of the opportunity on meeting the goal.
-	=	Net negative impact (without additional effort/mitigation) of the opportunity on meeting the goal.
+	=	Net positive impact of the opportunity on meeting the goal.
++	=	This rating was used for comparisons between similar opportunities.

In addition, the Matrices rank the capital costs for each opportunity. Rankings for the capital costs were based on the following criteria:

- Low - $ 1 million and could be funded under the existing operating budget and staff. A low rated opportunity could be accomplished in less than two years.

- Moderate – $ 1 million - $10 million and would require only minor changes to the existing operating budget. These opportunities could be accomplished in approximately two years.

- High – $10 and 100 million and would require a large capital investment. These opportunities would take greater than two years to implement.

- Very High – > $100 million and would require a large capital investment; accomplishment of this goal would require numerous years.

The cost rating includes the cost of design, environmental clearance, and construction.

Pond A18 Opportunities/Goals Rating Matrix.

OPPORTUNITIES	GOALS						
	Flexibility for Plant Land-Uses	**Regulatory Compliance**	**Worker and Community Safety**	**Habitat Protection and Restoration**	**Good Neighbor / Public Value**	**Economic Opportunities**	**Capital Cost**
Restore tidal marsh habitats	0	+	0	++	+	+	Moderate (~$5 million with no transition zone) to High (~$50 million with the transition zone)[1]
Flood protection improvements-South San Francisco Bay Shoreline Study	+	+	+	-	+	+	Potential for Federal, State and Local cost share[3]
Develop a wetlands mitigation bank	0	0	0	0	+	+	See costs for Tidal Marsh Restoration above
Install pulsed-discharge wastewater wetlands	+	+	0	+	+	-	High[2]
Conventional wastewater wetland	+	+	0	+	+	-	High[2]
Managed pond for shorebird breeding	0	0	0	+	+	-	Low[3]
Relocate/expand sludge drying beds	+	0	0	0	+	0	High
Public access	0	0	-	+	+	-	Low to Moderate[4]
Environmental education	0	0	0	+	+	-	Moderate

[1]Capital cost of High includes both the flood control levee and the transition zone.
[2]Capital costs are expected to be at the lower end of this range.
[3]Managed pond costs for Pond A18 are estimated using the SBSP A16 conceptual costs ($4.5 million) and assumes that the density of breeding islands would be greatly reduced for Pond A18 compared to A16.
[4]Cost would depend on the length of trail and complexity of design and construction.

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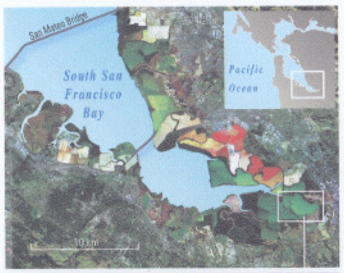
Appendix 7. Poster Presentation at 2007 Estuarine Research Federation Conference in Providence, RI.

Funky Green Biomass Machines: The Former Salt Ponds of South San Francisco Bay, CA

Julien Thébault[2], Tara S. Schraga[1], James E. Cloern[1], and Eric G. Dunlavey[3]

Mysterious new habitats

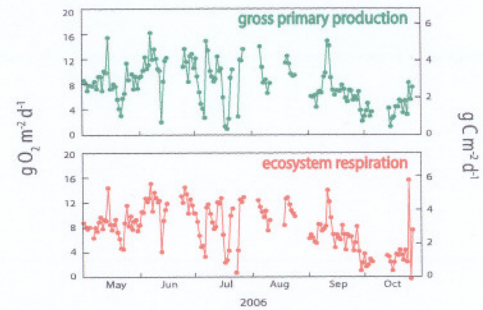
Over 6110 ha of the salt ponds surrounding South San Francisco Bay have been decommissioned, most as part of the largest wetlands restoration program in the western United States. These open water ponds are critical habitat for millions of birds, and program managers must determine the appropriate balance between ponds versus salt marsh, knowing both are essential habitats for endangered bird species. There is little information available on the ecosystem functions provided by these habitats, such as primary production.



We explored local production in Pond 18A as a representative system. Prior to opening in 2005, pond salinity was 110, presently the salinity ranges 2-22. Pond A18 is surrounded by a levy system with openings for the inlet and outlet.

What we discovered

Remarkably high gross primary production (GPP mean = 8.2 g O_2 m^{-2} d^{-1}), DOUBLE the rate of the world's most productive estuaries!

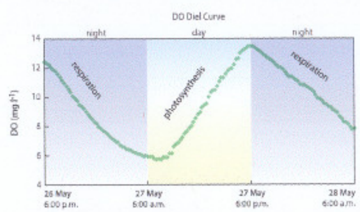


- High rates of photosynthesis were balanced by equally high rates of ecosystem respiration suggesting tight coupling and turnover of GPP.

- 84% of the respiration was heterotrophic implying high production rates of invertebrates and fish used as the forage base by waterbirds.

How we calculated primary production

We converted high-resolution timeseries of dissolved oxygen (O_2) into daily gross primary production and whole-ecosystem respiration (ER).



dissolved oxygen rate of change
$dO_2/dt = GPP - ER + D$

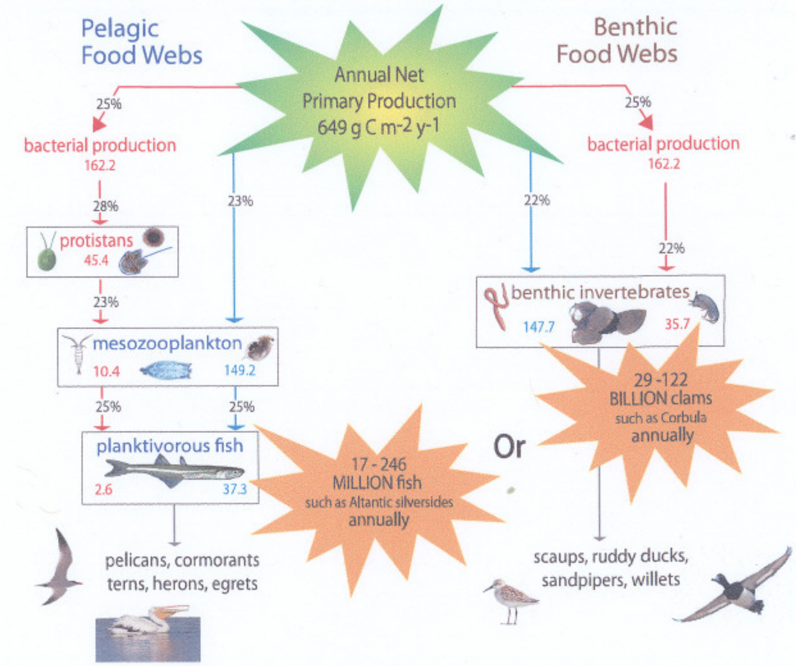
where D = atmospheric O_2 exchange. We assumed accrual from other water sources to be negligible due to the pond's long residence time (15-50 days).

GPP was calculated as the average of **daytime diffusion-corrected rates of oxygen change** and ER was calculated as average of **nighttime diffusion-corrected rates of oxygen change**. Volumetric rates were multiplied by mean pond depth (0.7 m) to yield areal rates presented here.

Calculations are detailed in the handout.

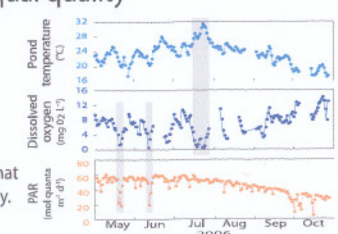
These ponds are for the birds

Idealized food webs and potential production of bird forage biota in Pond A18 based on annual net primary production (NPP). We transfer all NPP to either pelagic or benthic consumers through efficient algal-based (⟶) and inefficient bacterial-based (⟶) food webs, resulting in upper and lower bounds on carrying capacity. Percentages represent growth efficiencies, numbers represent production in grams Carbon m^{-2} y^{-1}.



Quantity does not equal quality

- The fast system metabolism is susceptible to weather events, such as storms and heat waves, triggering photosynthesis interruption resulting in oxygen depletion and hypoxia events
- Some phytoplankton in Pond A18 are toxic taxa that occur in habitats with long residence time and high organic content.
- Other ponds are densely colonized by macroalgae - biomass that is not easily accessible to consumers and degrades water quality.



What to take home

- These first measurements of primary production in the former salt ponds of San Francisco Bay quantify the high potential forage production and energy supply to shorebirds and waterfowl.
- The ponds are high-productivity bioreactors that are functionally analogous to aquaculture ponds, except their invertebrate and fish production are harvested by birds instead of humans.
- From a restoration perspective, these habitats are beneficial because of their food supply function, but detrimental because of their potential to produce toxic or inedible algae and susceptibility to hypoxic events. Adaptive management of San Francisco Bay's former salt ponds provides an opportunity to learn how algal biomass and quality respond to hydraulic manipulations through their control of flushing rate and residence time.

[1] U.S. Geological Survey, 345 Middlefield Rd., MS 496, Menlo Park, California 94025
[2] IUEM-UBO, UMR CNRS 6539, Place Nicolas Copernic, 29280 Plouzané, France
[3] City of San Jose, Environmental Services Department, 700 Los Esteros Rd., San Jose, California 95134

For further information, please contact Tara Schraga, email: tschraga@usgs.gov, tel: 650-329-4381